EP 66-40

14.4591

TRENDS IN OUTPUT, INPUTS, AND FACTOR PRODUCTIVITY
IN SOVIET AGRICULTURE

BY

STATINTL

5 May 1966

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TRENDS IN OUTPUT, INPUTS, AND FACTOR PRODUCTIVITY IN SOVIET AGRICULTURE

Introduction:

Since 1950 agricultural production in the USSR has increased by about

70 percent. The increase has been spread unevenly over this period, about

two-thirds of the increase having occurred in the 5 years following Stalin's

death (1954-58). Progress since 1958 has been disappointing to the Soviet

leadership. Per capita output in 1965 was less than in 1958, and in the last

three years, the USSR has had to import more than $1\frac{1}{2}$ billion dollars worth

of grain from Canada, Australia, and other non-Communist countries.

The steady growth in the Soviet population, the continued rise in per

capita income, and the rapidly rising expectations of the populace have

combined to generate higher demands on agriculture. A large part of this

demand is directed to the reduction in the proportion of starchy staples

(potatoes and bread) in the diet and a concomitant rise in the proportion

of quality foods (meat, butter, and fresh fruits and vegetables). Thus,

the Soviet leadership must respond to domestic pressures for a better -- and

more costly -- product mix as well as free itself from major dependence on

Western sources of food.

Contrary to popular belief, the Soviet regime in this 15-year period

has not neglected agriculture. Since 1950 annual inputs into agriculture

have grown by one-third and have included several costly new programs that

required heavy support from industry. What has been lacking has been a well

conceived and sustained effort directed to such basic problems in Soviet

agriculture as raising the level of technical skill and improving the system of management and incentives.

The difference between the 70-percent growth in output since 1950 and the one-third growth in inputs is of course the effect of the increased productivity of the resources devoted to Soviet agriculture. Today, the combined productivity of the land, labor, capital, and other conventional inputs in agriculture is about 25 percent greater than in 1950. This means that the package of resources used in agriculture in 1966 would yield one-quarter more output than the same resources used on 1950. All of this gain in productivity occurred before 1959; in the last few years increases in output have been attributable solely to additional inputs.

Some of the elements involved in changes in factor productivity in Soviet agriculture are: (1) improvement in production techniques and the application of new knowledge over a wider area; (2) a rise in the level of education and training of the labor force; (3) improvement in the training and skill of managers and administrators; (4) improvement in the system of management and incentives; (5) economies of scale resulting from, say, an increase in the size of the individual farm or from a pooling of repair facilities for farm machinery; and (6) improvements in the efficiency with which inputs are combined and used.

The purpose of this paper is to present estimates of output, inputs, and factor productivity in Soviet agriculture since 1950 and to analyze the relationships among these elements for the 15-year period and for important subperiods. Section II provides indexes of agricultural output, divided

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between crops and livestock; a separate index of output is calculated using

a three-year moving average to reduce the effect of year-to-year fluctuations

due to weather conditions. Section III presents estimates of inputs in

Soviet agriculture: labor, fixed capital (buildings and machinery) land,

current purchases (fertilizer, supplies etc.), and livestock. Section IV

brings together the results of Sections II and III and presents indexes of

factor productivity. Section V examines some of the reasons for variation

in factor productivity since 1950, in particular the reasons for the failure

of factor productivity to rise in the last few years. Four Appendixes give

technical details on the calculation of the indexes and the selection of the

proper formula.

II. Agricultural Output During 1950-65

A. Measures of Agricultural Output

1. The Soviet Gross Output Index

The index of gross value of agricultural output published by the

USSR is not accepted by Western analysts as a reliable indicator of agricultural

growth. The problems are two-fold. In the first place, the official gross

value concept includes intra-agricultural uses of farm products (for example,

feed for livestock) and thus leads to various degrees of double counting between

any two years. 1/ In addition, the official index covers the value of

activities not relevant for inclusion in a measure of farm output --

unfinished production and land preparation for the following year. 2/

A more serious problem with the official measure of gross output,

however, is the unreliability of official production data for some of the

major agricultural commodities. There is evidence of large and varying

amount of exaggeration in official claims of grain output. Similarly, though

to a lesser extent, an upward bias is believed to be present in the output

data for oilseed crops, meat, and milk. The evidence also suggests that most

of the exaggeration in official production series has been a post-1958

phenomenon and that the published data for the period 1950-58 are, for the

most part, reasonably reliable. Acceptance of the official claims of absolute

output since 1958 leads not only to inflation of levels of output for any

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1/ An official index net of all purchases from within agriculture and from
other sectors has, however, been published for some years.

2/ TsSU, Narodnoye khozyaystvo v 1964, Moscow, 1965, p. 812, (hereafter
referred to as Narkhoz 1964 or for other years in the series of official
Soviet Statistical Yearbooks). In addition, an admixture of prices is used
in computing the official measure -- actual 1958 prices paid for marketed
produce, average cost of production for non-marketable output. The latter
two sets of unit values diverged significantly in 1958. Planovoye
khozyaystvo, no. 6, 1963, p. 64-70.

given year in the period 1958-65 but also exaggerates the trend when

comparison is made with 1950-57. The specific deficiencies of Soviet

output data for selected commodities have been thoroughly analyzed by Western

students and need not be reviewed here. 3/ Among the charges levelled by

one or more of the above sources are: (1) padding of production data at the

farm and local level (meat, milk), (2) outright falsification of data at both

farm and national levels (grains), and (3) faulty sampling procedures in

obtaining official estimates in the important private sector (principally

animal products, potatoes, and vegetables).

    2. Construction of an Adjusted Net Output Index

    The physical commodity series underlying the agricultural production

indexes presented in this paper rely in part on independent estimates for

selected products (the individual grains); in part on estimates that reflect

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3/ See the following references:
    Joseph W. Willett,"The Recent Record in Agricultural Production" in
Dimensions of Soviet Economic Power, Joint Economic Committee, U.S.Congress,
1962, p. 96-98.

    CIA, ER 62-33, Recent Developments in Soviet Agriculture, Washington,
D.C. November 1962, p. 8-10.

    D. Gale Johnson, "Agricultural Production" in Economic Trends in the
Soviet Union (edited by Abram Bergson and Simon Kuznets) Harvard University
Press, 1963, p. 212-13, 233.

    Arcadius Kahan, "Soviet Statistics of Agricultural Output" and commentary
by Luba O. Richter in Soviet Agricultural and Peasant Affairs, (edited by Roy
D. Laird) University of Kansas Press, 1963.

    CIA, ER 64-33, Production of Grain in the USSR, Washington, D.C., October
1964, Appendix A.

    U.S. Department of Agriculture, The 1964 Eastern Europe Agricultural
Situation, ERS - Foreign 73, Washington, D.C., 1964, p. 9-13.

downward adjustments of official claims for other products (oilseeds, meat,

milk); and for the balance of the list on the acceptance of official data. 4/

The indexes shown in Table 1 are based on the physical output for

major crops and animal products, including changes in inventories of livestock,

weighted by 1958 prices. In order to obtain a net measure of the physical

amounts available for sale or home consumption, deductions were made for

the amounts of grain, potatoes, and milk fed to livestock and for the amounts

of grain and potatoes used as seed. 5/ The commodity groups included in the

index probably embrace more than 95 percent of the total value of farm

products available for sale and home consumption; the major exclusions are

fruits and oilseed crops other than sunflowers.

Errors in the estimates of production for individual commodity

groups may be significant. Major or minor adjustments in the official claims

were made for commodities covering 45 percent of the ruble value of average

annual net production for each year in the period 1950-55 and 73 percent in

1958-65. Moreover, crude estimating techniques were necessarily used for

deriving the deductions in the use of potatoes and grain as livestock feed,

the value of which varies between 6 and 12 percent of total net agricultural

production.

4/ Acceptance of unadjusted official estimates does not necessarily mean
that the evidence clearly implies that output claims for the commodities
involved are valid. Often the evidence is ambiguous concerning the accuracy
of certain official series (for example, production of potatoes) so that,
lacking clear-cut indicators to the contrary, most investigators have
accepted the official estimates.

5/ See Appendix A for more details concerning the methodology used in
computing the index of agricultural output.

Table 1

USSR: Indexes of Net Agricultural Production,
1950 - 65 a/

1950 = 100

	Total	Crops	Livestock
1950	100	100	100
1951	97	91	105
1952	104	102	110
1953	106	97	119
1954	109	99	123
1955	126	118	137
1956	141	138	145
1957	141	126	160
1958	155	143	172
1959	149	122	185
1960	150	124	184
1961	163	135	200
1962	161	129	204
1963	153	118	199
1964	170	157	186
1965	171	141	212

a/ For commodity composition and procedures for deriving indexes, see Appendix A.

Despite these caveats, the indexes are believed to be reasonably reliable indicators of trends in the availability of farm products for sale and home consumption during 1951-65. Nevertheless, they should not be taken as precise indicators of change between any two years.

The production index is computed with 1958 price weights so as to conform as nearly as possible with the 1959 price weights used in constructing the index of total resources employed in agriculture. 6/ Although a case can be made for the use of relative prices of a more recent vintage, alternative indexes constructed with 1963 and 1965 price weights had about the same overall configuration as the index in Table 1. 7/

B. Trends in Net Agricultural Production

Net agricultural production increased by about 70 percent between 1950 and 1965. The major part of this growth took place during the last half of the 1950's when output expanded by 40 percent. During the first half of the present decade, the rate of growth slowed, and by 1965 production was only 14 percent above 1960. In order to reduce the effect of annual variations in weather on the annual index of output, rates of growth shown in Table 2 have been computed by use of 3-year moving averages as well as on the basis of estimated output in single years.

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6/ The price relatives for 1959 (actual prices paid) were, with the exception of eggs, about the same as the relatives for the base prices established in 1958.

7/ See Appendix A.

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Table 2

USSR: Average Annual Rates of Growth of Net Agricultural Output
Selected Periods, 1951-65 a/

	Straight Annual Average	Moving Average for 3 years b/
1951-64	3.8	3.7
1951-53	2.0	2.4
1954-55	9.2	8.7
1956-59	4.2	4.8
1960-64	2.6	1.7
1961-65	2.7	

a/ The base year for the calculations shown in each line is the year before the stated initial year of period, i.e., the average annual rate of increase for 1951-53 is computed by relating production in 1953 to base year 1950.

b/ Average annual rates of growth/computed by relating the 3-year average
                               were
for the terminal year (for example, output in 1953 as the average for 1952, 1953, and 1954) to a similar 3-year average for the base year (1950).

The 3-year average dampens, but does not completely eliminate the effect of changes due to weather. 8/ A comparison of the value of net farm output during the three successive 5-year periods affords a still broader view of relative changes over the past 15 years:

	Net Output for 5-year Period a/	Average Annual Output
	(billions of rubles)	
1950-54	133.08	26.62
1955-59	184.02	36.80
1960-64	205.32	41.06

a/ Billions of rubles in 1959 prices. Computed by moving the total value of output for sale and home consumption in 1959 (38.48 billion rubles) from Appendix C by the index of output in Table 1.

8/ About three-quarters of the sown area in the Soviet Union in 1958 was in areas similar in climate and soil to the Great Plains States of North Dakota, South Dakota, Nebraska, Montana and Wyoming, and the Prairie Provinces of Canada. The North American counter-part, due to variations in weather conditions, have had a long history of strong swings in crop yields. Acreage data from Narkhoz. 1958, p. 398. Climatic analogues from D. Gale Johnson, Climatic and Crop Analogies for the Soviet Union: A Study for the Possibilities of Increasing Grain Yields, the University of Chicago, Office of Agricultural Economics, Research paper No. 5716, December 16, 1957, p. II, 7-8.

Annual net production in the period 1955-59 averaged 38 percent above the average annual level in 1950-54. But in 1960-64 average annual output was only 12 percent above the annual average level in 1955-59.

Although there have been cyclical swings in weather and growing conditions within each of the 5-year periods, it is doubtful if weather factors accounting for more than a minor part of the marked divergence between levels of production in 1950-54 and 1955-59 on the one hand, and 1955-59 and 1960-64 on the other. During 1950-54 there were (roughly) two years of slightly favorable growing conditions (1950 and 1952); and two years when more or less normal conditions prevailed (1953 and 1954) and one sub-normal year (1951). 9/ In each of the later two 5-year periods (1955-59 and 1960-64) there were single years of exceptionally favorable growing conditions (1958 and 1964), another pair of above average crop years (1956 and 1961), and two years in each period when conditions could be described as more or less normal (1955 and 1957; 1960 and 1962). The last period, however, included one year of exceptionally poor growing conditions (1963), probably not matched by any other single year in the entire period 1950-65. If the value of net output in the single year with the most unfavorable growing conditions in each of the three 5-year periods (1951, 1959, and 1963) is deducted from the values shown above, the aggregate increases in output in 1955-59 and 1960-64 comes to 35 and 14 percent, respectively, as compared with 38 and 12 percent for the full 5-year periods. 10/

9/ "Normal" in the sense that there were adverse weather conditions in at least one major producing region and above-average growing conditions in others.

10/ Under Soviet conditions there is usually a one-year lag between a bumper crop and its effect on production of animal products. Hence, in the single "worst crop" year chosen from each of the three periods output of livestock products actually increased in two of the three (1951 and 1959), reflecting the carryover of good supplies of feedstuffs from the previous year.

III. Agricultural Inputs During 1950-64

The increase in farm output since 1950 has been associated with large

increases in four of the five major categories of inputs considered in this

paper -- fixed capital (buildings and machinery), land, purchases of materials

from outside agriculture, and livestock herds. Use of the most important

factor -- labor -- has fluctuated only narrowly throughout the 15-year

period. Indexes for each of the five inputs are presented in Table 3.

Although full documentation of the estimates underlying these indexes

await future publication, a general description of the data used for each

series is presented below, with further elaboration in Appendix B.

A. Labor Inputs

Indexes of labor inputs are presented in two series in Table 3: one

is based on the number of persons principally or exclusively engaged in farm

activity (the farm labor force) and the other is based on an estimate of the

number of man-days worked. Although the two series do not diverge substantially

during 1950-64 there are important differences in concept because: (1) the

average number of days worked per year by each member of the farm labor force

may vary and (2) a substantial proportion of total days expended in producing

farm commodities is accounted for by persons principally occupied in non-

agricultural pursuits and, hence, not counted in the farm labor force. 11/

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11/ See Appendix B for a more complete explanation of the coverage of the
measure for farm employment. In the USSR there are a large number of
households not attached to farming enterprises which maintain small holdings
of sown acreage (plots of kitchen-garden size) and livestock. Besides
providing a secondary source of income, these small subsidiary holdings
frequently supply certain perishable foods (especially milk, potatoes, and
vegetables) otherwise unavailable for various periods of time in local retail
outlets. Local shortages of perishable foodstuffs in state-controlled retail
outlets frequently occur because of malfunctioning of the distribution system;
less frequently they occur because of serious shortfalls in state procurements
resulting from crop failures.

Table 3
USSR: Indexes of Inputs Used by Agriculture, 1950-64 a/

1950 = 100

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Labor															
Man-days b/	100	N.A.	91	93	95	100	101	98	98	98	94	94	94	91	91
Employment c/	100	96	93	93	92	93	94	96	101	99	95	94	96	94	95
Fixed Capital d/	100	111	122	134	146	164	187	209	234	260	286	310	342	384	432
Current Purchases	100	110	112	138	145	152	158	169	184	193	203	221	239	262	279
Land e/	100	105	107	109	114	126	131	131	132	133	135	137	146	144	141
Productive Livestock f/	100	105	110	113	121	131	141	151	162	170	172	176	184	187	187

a. The various series of "physical" or value measures from which these indexes are derived are shown in Table 14
b. All man-days expended in farm activity.
c. Limited to persons principally or exclusively engaged in farm activity.
d. Average of stocks at end of given and previous year. Includes value of draft animals.
e. Sown acreage weighted by average grain yields 1949-58.
f. Average of stock values at end of given year and previous year.

The labor force in agriculture is comprised mostly of persons from households attached to socialized agricultural enterprises (collective farms, state farms, etc.). Although the number of days worked per person in socialized farm activity has fluctuated narrowly since 1950 there have been annual variations in number of days worked by members of these households in their own subsidiary enterprises. These fluctuations, in turn, have for the most part been related to the changes in official restrictions on size of "private" holdings of land and livestock. 12/

In 1958 between 82 and 83 million persons probably participated at some time during the year in farming activity as compared to only 41.5 million persons engaged principally or exclusively in agricultural pursuits. 13 / Although persons from non-agricultural households work only a nominal number of days in farm activity per year the magnitude of the numbers involved (equal again to the farm labor force) makes their contribution of considerable importance. 14/

The preference of one measure over the other depends on the purpose to be served. For productivity accounting in the conventional sense, the

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12/ Although there is contradictory evidence as to whether man-day inputs have varied on these plots when expressed as days per hectare or per head of livestock, the evidence, on balance, I believe, suggest slight fluctuations during the period 1950-64. For a view to the countrary, (i.e., moderate to large fluctuations in man-days per unit) see Nancy Nimitz, Farm Employment in the Soviet Union, 1928-63, RM-4623-PR, The Rand Corporation, Santa Monica, California, November 1965.

13/ The estimate of 82 to 83 million total is for persons age 12 or over and represents more than one-half of the total population of 154 million age 12 or over for the USSR in 1958. (Population estimates are from Foreign Demographic Analysis Division, Bureau of the Census -- unpublished).

14/ I have estimated that about 730 million days were expended in farm activity by these households in 1958 or about 7 percent of the total number of man-days expended in farming activity. The implied average of about 18 days per person can be compared to an average of about 250 days worked per participant (age 12 and over) in collective farms, either in employment on the farm or in their families holdings of small land allotment and livestock.

man-day series is the more relevant measure. But from the viewpoint of

alternative returns foregone to the economy the use of the series on persons

principally or exclusively engaged in agriculture may be more appropriate.

For example, the planners may view labor expended (in man-days) on subsidiary

farm activity by households outside of agriculture as having zero return in

other uses, i.e., they may believe the alternative to work on the plot is

leisure. 15/

B. Other Inputs

The index of capital stock shown in Table 3 reflects the gross

value of reproducible physical assets (buildings, structures, equipment)

and draft animals. Values are expressed in replacement cost ("constant"

1955 prices) gross of depreciation and net of retirements. The productive

livestock index is based on the inventory value of herds of mature "productive"

animals excluding draft animals. Young animals and those being raised

exclusively for slaughter are also excluded.

The index for materials purchased from sectors outside of agriculture

is based on purchases of fertilizer, electric power, fuels and lubricants,

current repair services, and industrially processed feedstuffs. The sample

of goods and services covered in the index included 92 percent of the total

ruble outlays by farms for current purchases in the base year (1959).

In the case of land, the index is obtained by weighting the sown

acreage in 25 regions with average grain yields, i.e. the index number for

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15/ Official policy towards private activity in agriculture has vacilliated
during the period under review and appears to be related more to ideological
considerations than economic calculations.

each year is calculated by weighting the area sown in each region that year by

the average grain yield for that region in 1949-58. This method ought to

yield reliable results for two reasons: (1) the preponderance of grain

acreage in total acreage (about 64 percent for the period 1950-64), and

(2) the relative homogeneity of at least three-fourths of acreage with

respect to prevailing climate and soil. 16/

C. Weighting of Inputs

The five series of inputs are combined by use of 1959 weights that

represent the monetary or imputed costs attributed to each of the inputs.

Data are available on actual expenditures for labor and for current purchases

from other sectors of the economy, but not for the other inputs because there

is no explicit accounting in the USSR for returns to land, fixed capital, and

productive livestock. In order to obtain an "expenditure" weight for the

latter two, rather arbitrary assumptions were adopted. First, the income

share or service flow for these two factors was derived by assuming alternative

interest rates of 8 and 13 percent, and depreciation allowances for capital

(excluding draft animals) were than added in order to obtain a gross return

on total capital stock. 17/ The return to land was taken as a residual --

value of agricultural output minus the expenditures or service flows for the

other four categories of inputs. 18/

16/ See footnote p. 9, above. In a market economy an appropriate measure would
take into account quality differences in land by use of relative prices in a
base year. The base-year value could be extrapolated by use of a quantity
indicator that reflected further qualitative changes from investment or
disinvestment in land (drainage, irrigation) as well as changes in relative
prices paid for products if all hectares of sown acreage were not substitutable
in their production.

17/ See Appendix C for explanation of choice of alternative rates of return of
9 and 13 percent.

18/ The value of agricultural output for purposes of distributing inco.. among
the several factors considered is defined as the value of sales by the farm
sector as intermediate product to other producing sectors (e.g., light and food
industry) plus sales directly to consumers plus value of production consumed
by producers (consumption-in-kind) plus subsidies to farm enterprises. See
Appendix C. for computations.

The shares of each input in total costs of production under the assumptions about alternative weights (interest rates) for capital assets and livestock are shown in Table 4.

Table 4

USSR: Shares of Inputs in Total Agricultural Costs,
1959

	Percent	
	Rate of Interest	
	8 Percent	13 Percent
Input		
Labor	57.3	57.3
Fixed capital	8.4	11.8
Current purchases	14.1	14.1
Land	17.3	12.1
Livestock	2.9	4.7
Total a/	100.0	100.0

a/   The shares expressed as coefficients in the production function in four significant places are shown in Appendix C.

Four alternative indexes of total inputs are presented in Table 15, p. 78, with (1) interest rates of 8 and 13 percent and (2) use of two measures of labor input, man-days and numbers of persons principally engaged in farm activity. 19/   In the following Section, primary attention is focused on one of the four indexes -- that based on an 8 percent rate of return on capital and livestock and the use of man-days as the measure for labor. This procedure simplifies the textual presentation, but Table 16 (Appendix D) gives calculations of factor productivity using all four indexes of inputs alternatively. All of the four series, however, show about the same overall trend in factor productivity for 1951-64. 20/

19/ All indexes are obtained by combining the several series in a geometric formula. The implications of the choice of production function and the weighting system are discussed in Appendix C.

20/   In other words the trend in combined inputs for 1951-64 is approximately the same when any one of the four series are considered (See Table 16 - Appendix D).

IV. Trends in Inputs, Output, and Factor Productivity

For the period 1951-64 as a whole, inputs in Soviet agriculture increased

by roughly one-third compared to a growth in output of 70 percent. If the

growth of output had been based solely on the use of additional quantities

of conventional inputs, only about one-half of the gains would have been

achieved. The difference between the observed average annual rate of increase

in agricultural production of about 3 1/2 percent (moving 3-year average) and of

additions to inputs of 2 percent was due to an average annual increase of some

1 1/2 percent in productivity. But the averages for the whole 14-year period

obscure important differences in trends of output, inputs, and productivity

for several sub-periods (see Table 5).

A. 1951-53

In the closing years of Stalin's rule (1951-53) small advances in

inputs and factor productivity, averaging about 1 1/2 and 1 percent per year

respectively, combined to give an overall boost in production of nearly 2 1/2

percent per year. This period was marked by a 7 percent reduction in labor

input (both employment and man-days) and a one-third increase in capital assets.

But the moderate gains in 1951-53 were not in keeping with the ambitions of the

post-Stalin leadership or the demands of the populace. 21/

21/ Net production in 1953 was about 14 percent above 1940 on comparable
territory and approximately the same on a per capita basis. For the index
of production relating 1940 to 1953, see Johnson, in _Economic Trends..._, _op. cit._,
p. 211.

Table 5
Approved For Release 2001/04/12 : CIA-RDP79T01049A003200150001-9 ...Productivity
in Agriculture, 1951-64

	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
												1950 = 100		
Index of output a/														
Straight annual	97	104	106	109	126	141	141	155	149	150	163	161	153	170
Moving average for 3 years	101	103	108	115	127	138	147	150	153	156	160	160	163	166
Index of total inputs when labor is expressed as: b/														
Man-days	N.A.	99	105	109	116	120	121	123	125	125	128	132	132	134
Employment	101	101	105	107	111	115	119	125	126	126	128	133	134	137
Indexes of factor productivity b/														
Man-days	N.A.	104	103	106	109	115	121	122	122	125	125	121	123	124
Employment	100	102	103	107	114	120	124	120	121	124	125	120	122	121

	Average Annual Rates of Growth (Percent)								
		1951-55			1956-60			1961-64	
	1951-55	1951-53	1954-55	1956-60	1956-58	1959-60	1961-64	1961-62	1963-64
Output - (3-year moving average)	4.9	2.4	8.7	4.2	5.8	1.8	1.7	1.5	1.8
Total inputs									
Man-days	3.0	1.6	5.1	1.5	2.0	0.8	1.8	2.8	0.8
Employment	2.1	1.6	2.8	2.6	4.0	0.4	2.1	2.7	1.5
Factor productivity b/									
Man-days	1.7	1.0	2.9	2.8	3.8	1.2	-0.2	-1.6	1.2
Employment	2.7	1.0	5.2	1.7	1.7	1.7	-0.6	-1.6	0.4

a. Data from Table 1.
b. Data from Tables 15 and 16, Appendix D. Index of output for computing factor productivity based on 3-year moving average. Index of inputs is a weighted index of the five categories of conventional inputs -- land, capital, current purchases, livestock and labor measured, alternatively, in man days and numbers of persons principally engaged in farm activity. The coverage for the man-day measure includes total days worked in production of farm products regardless of whether worked by persons with farming as a principal or secondary source of income. For purposes of this Table the inputs are combined (in a geometric function) using an 8 percent interest charge for capital and livestock.

B. <u>1954-55</u>

A surge in additional commitments of resources in 1954-55 raised

aggregate inputs an average of more than 5 percent per year. Most notable was

the expansion of sown acreage, highlighted by the "new lands" program, which

in two years, increased the use of land under crops by 18 percent. Although

employment remained steady, partial relaxation of restrictions on private activity

in agriculture and increased incentives in the socialized sector brought about

an 8 percent increase in man-days over the two-year period. In addition, the

new regime sustained the rapid increase, begun in 1953, in sales to the farm

sector of petroleum, fertilizer, and other industrial products. The high rate

of growth in inputs combined with a marked improvement in productivity (up

3 percent a year) resulted in an average annual rate of increase in output

of more than 8 1/2 percent for the two-year period.

C. <u>1956-60</u>

For the following five-year period (1956-60), productivity continued

to expand at about the same rate as in 1954-55 (3 percent), but the average

annual growth of inputs fell from 5 percent to 1 1/2 percent. This fall was

accompanied by a sharp decline in the average annual rate of increase in output

-- from an average of 8 1/2 to 4 percent. However, the deceleration was

gradual and average annual productivity rose by nearly a percentage point

during 1956-58 (3.8 percent compared to 2.9 percent in 1954-55).22/ These

gains in productivity are at least partly attributable to favorable weather

in 1956-58.

22/ These are the comparative rates when output is centered on a three- year
average. Use of <u>actual</u> output in the base year 1955 and terminal year 1958
would show an average annual productivity gain of nearly 5 percent.

Whatever the underlying causes of this relatively rapid productivity

gains in 1954-58 and especially in 1956-58, the striking success in in-

creasing farm output by some 46 percent with the use of only 17 percent

resources
more/led Khrushchev to base future plans on over-optimistic assumptions.

His principal innovations, the expansion of sown acreage in the "new lands"

and the substitution of corn for other grain and fodder crops, apparently

were huge successes and may have accounted for at least one-quarter of the

increase in output in the period 1954-58.

In this atmosphere of euphoria, future commitments were made to the

consumer -- the USSR would catch-up with the United States in per capita

meat and milk production in 3 or 4 years -- and a marked slackening of

the rate of growth of inputs was planned. In 1959 and 1960 inputs increased

by less than 1 percent per year compared with 3 percent annually during

1954-58. 23/   The levelling off in total inputs was highlighted by a 6-

percent reduction in the number of persons principally engaged in farm

activity that reversed the upward trend of 1954-58 in numbers employed.

D. 1961-64

When centered on a three-year average, output in 1960 was some 3 1/2

percent above 1958; but actual production had declined about 3 1/2 percent

in 1959 and had remained about the same in 1960. The failure of agricultural

production during these two years to maintain the forward momentum of the

earlier period apparently convinced the regime that additional resources
23/ Inputs, using man-days as the indicator of labor use, rose by about
1 1/2 percent in 1959 and levelled off in 1960; total inputs, using persons
principally engaged in agriculture as the indicator of labor use, were
the same in 1960 as in 1959 after a 1 percent rise in 1959.

were needed. Beginning in 1961 reductions in the farm labor force

were halted; annual deliveries of new machinery to agriculture, which

had declined by 20 percent in the period 1958-60, were boosted so that

by 1962 they had nearly recovered the 1958 level. Meanwhile, Khrushchev

introduced another major change in land use -- a radical shift in the

pattern of cultivated acreage. The new campaign called for a sharp reduc-

tion in area given over to sown grass, oats, and clean fallow and a com-

parable expansion in more intensive crops -- small grains, corn, sugar

beets, peas, and field beans. This program, launched during the 1962 crop

year, had the net effect of expanding total sown acreage by about 14 million

hectares in two years thus increasing land inputs by an average of 2.5

percent a year.

As a result of these and other measures total inputs expanded by more than

7 percent over the period 1961-64, an acceleration to an average annual rate

of growth of nearly 2 percent a year compared with less than 1 percent in

1959-60. Output, however, did not grow as fast as inputs and overall produc-

tivity declined by about 0.2 percent a year.

.E, Trends for Five-Year Periods

In Section I comparisons of changes in average annual output were

made for the three five-year periods 1950-54, 1955-59, and 1960-64. This

was done in an effort to dampen cyclical effects on agricultural output from

changing weather conditions.

When productivity comparisons are made for 5-year periods, as was done above

for output, the following results are obtained:

(1) Total inputs for each of the years in the period 1955-59 averaged

about 18 percent above the average for each year in the period 1950-54; out-

put averaged 38 percent higher. Therefore, additions to production not

attributable to additional inputs came to an average of 20 percent for each

of the years in the latter half of the decade compared to each of the years

in the period 1950-54.

(2) For each of the years in the following five-year period (1950-64)

total resources committed to the farm sector were on the average 7 1/2 percent

above each of the years in the period 1955-59; output averaged 12 percent

higher. Increases in production not explained by additional resources came

to 4 1/2 percent 24/

(3) The ratios of additional output per unit of additional input came

to 17 1/2 percent in 1955-59 and 4 percent in 1960-64.

24/ If the single year in each period with the most unfavorable weather
conditions is excluded (1951, 1959, and 1963) from both the input and
output side, the additions in production (35 and 14 percent, respectively)
not attributable to additional resources comes to 18 and 6 percent,
respectively.

F. Limitations on the Meaning of the Results

Interpretation of the trends in output per unit of input of combined

resources is subject to limitations imposed by assumptions concerning the

nature of the aggregate production function for Soviet agriculture as a whole.

The most important limitation is imposed by the assumption that all agricultural

inputs can be aggregated into a single production relation. The serious

reservations about the specification of a single production relation for the

agricultural sector of any country apply particularly to the Soviet Union

because of the artificial compartmentalization of agriculture into three

"sector." Roughly one-third of gross agricultural output is produced by the

"private" sector, comprising individual holdings of one and one-half acres

or less, frequently combined with one or two head of livestock. The balance

of farm output is produced in large enterprises in the socialized sector

(collective and state farms). The former is organized nominally as a

"producer's cooperative", whereas the latter is organized along the lines

of a state-operated industrial enterprise.

The most distinguishing characteristic among these three forms of

organization lies in the use and remuneration of labor services. In the

small subsidiary holdings of individual households labor is intensively

applied to the point of fairly low physical returns; remuneration is directly

tied to output. In the case of the collective farm, labor is used according

to the dictates of the collective farm chairman; labor is remunerated as the

residual claimant of the farm's gross income, receiving whatever is left after

claims have been met. In the case of the state farm, which is operated

- 23 -

directly by the Government, the labor force is used in a fashion comparable to the industrial labor force; remunerated at a fixed wage or salary invariant to the net earnings of the farm. 25/

More relevant to the problem of aggregation of all farm labor is the strikingly different degree of mobility of the labor force in each of the two types of socialist enterprises. The collective farm peasantry is the only large social group of Soviet society that is not issued internal passports, the formal prerequisite for freedom of movement and choice among alternative employment opportunities. 26/

In contrast, the state farm worker has the same legal status as the industrial or other non-agricultural employee and, hence, faces considerably less restriction on entry into non-farm employment.

The differences in the method of remuneration of labor services and in the degree of labor mobility have had a marked effect on average wages in collective and state farms. A Soviet study in 1963 indicated that in "recent years" the average payment per man-day for collective-farm labor in all farm activity -- private plot and collective farms -- was only two-thirds of the average wage of workers in local industry, whereas the average daily wage of state farm workers came to nearly 90 percent of that of workers in local industry. 27/

25/ The wage workers on state farms do receive bonuses for overfulfilling output goals usually expressed in physical terms. Managerial salaries are related to gross earnings of the state farm.

26/ Murray Feshbach, The Soviet Statistical System: Labor Force Recordkeeping and Reporting Since 1957, Bureau of the Census, International Population Statistics Reports, Series P - 90, No. 17, Washington, D.C., 1962, p. 14.

27/ R.V. Alekseyeva and A.P. Voronin, Nakopleniye: razvitiye kolkhoznoy sobstvennost', Moscow, 1963, p. 29. Local industrial enterprises are concentrated in rural areas and their labor force is relatively unskilled.
    Much of this difference in wages between collective and state farms can be explained by the higher productivity of labor in state farms due to the use of relatively more machinery and other forms of capital.

Given the disparities in the organization and payment of labor among

the three sectors an aggregation into a single measure of all labor engaged

in farm activity may impart a bias to the computed index of total inputs. 28/

The coefficient or "weight" assigned to labor in the formula used to compute

factor productivity assumes that the value of marginal product of labor is

equal to the average net productivity in each of its uses. Intuitively,

in the case of the private sector, this may well not be true i.e., amount

added to total product by the addition of one more man-day of labor may be

considerably below the average net product for all man-days in private farm

activity. Moreover, the lack of mobility between collective and state farms,

the considerably higher wage for comparable labor in the latter, and the

evidence that persons in the labor force of the collective farm would (if

permitted) shift to state farms indicates that alternative returns for use

of labor (as between collective and state farms) are not equal to the value

of marginal product in each of the two sectors. Thus, a shift over time in the

proportion of total labor used in socialized agricultural enterprises from

collective to state farms (to a more "efficient" combination of resources)

would show up as an increase in factor productivity. In other words, a shift

over time from a disequilibrium combination of resources towards an equilibrium

combination will result in a rise in output per unit of total inputs (other

things being equal).

28/ The shares of man-day inputs in farm activity attributable to the three
sectors in benchmark years is estimated to have varied as follows:

Sector	1950	1959	1964
		(percentage share)	
Private	30.7	35.2	35.3
Collective farm	61.8	50.4	43.1
State agriculture	7.5	14.4	21.6
Total	100.0	100.0	100.0

Another limitation on the acceptability of the series on factor

productivity stems from the assumption that the cost of an individual input --

the basis for determining the weight or "coefficient" assigned each of the

categories of inputs -- represent the value of its marginal product. If

there is a divergency between the price paid by farms for a factor of

production and its net return (value of its marginal product) agriculture

is again said to be in "disequilibrium."
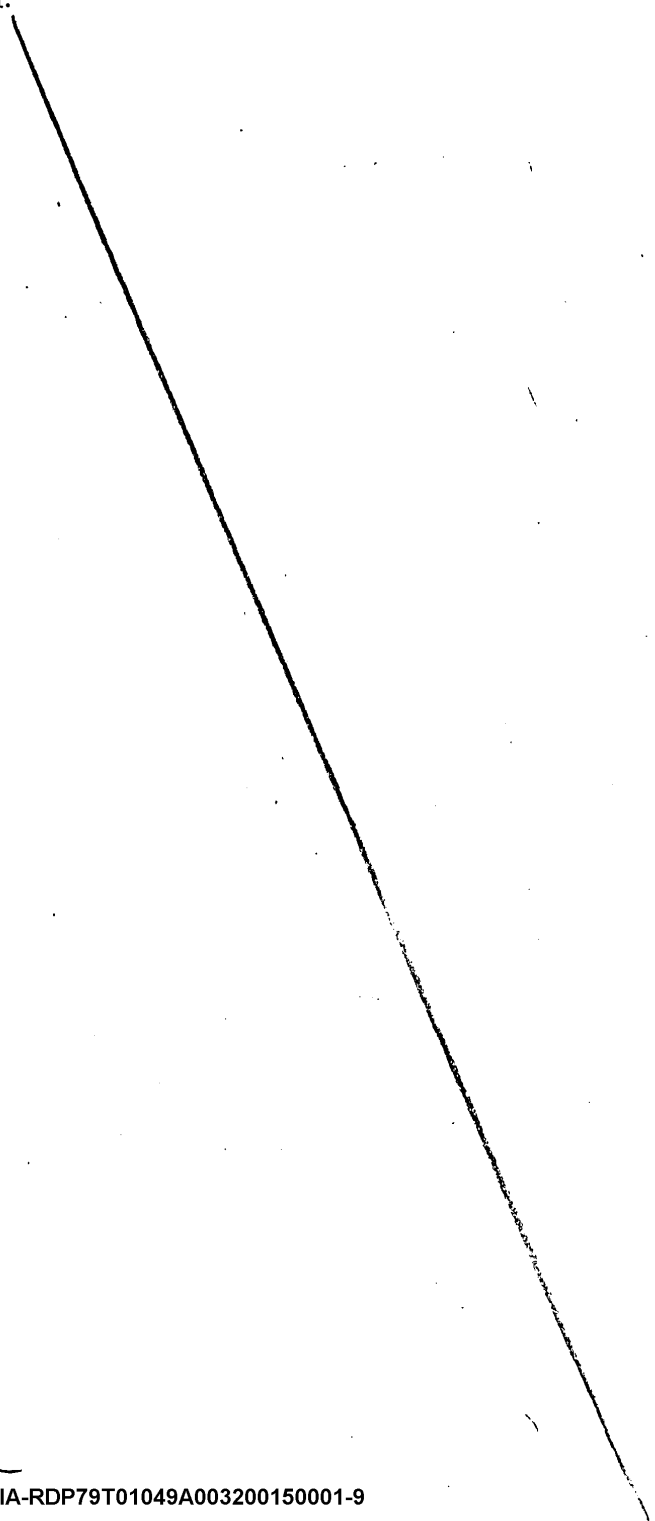
Recent work done on estimating the aggregate agricultural production

function in the United States shows that large differentials exist between the

price paid by farmers for certain resources and the value of their contribution

to production. In the case of fertilizer, for example, the ratio of marginal

product to cost was as high as 5 to 1. 29/ A mis-specification of the weights

in the production relation used in this paper due to the assumption that the

contribution of each factor is equal to its relative share in total costs

could be a source of bias in the results. This is because several categories

of inputs have had markedly different trends over time.

Finally, the weight assigned to land varies arbitrarily because its

contribution to output was calculated as a residual. This variation in the

residual is caused by the absence of an explicit rate of return on fixed

---

29/ Zvi Griliches, "Research Expenditures, Education, and Aggregate Production
Function," The American Economic Review, December 1964, p. 968. Griliches has
estimated that the "disequilibrium gap" (ratio of value of marginal product
to factor price) for fertilizer in US agriculture has declined from about 5 to
1 in 1959 to 2.7 to 1 in 1959 and 2.4 to 1 in 1962. Griliches derived a
statistically estimated production function in which he estimated the coefficients
for each of several inputs "independently" of their relative shares in total
costs. The method used in the present paper -- derivation of the coefficients
by use of observed input market prices or their relative shares in total costs --
is comparable to the approach used by the Department of Agriculture in estimating
"factor productivity" in US agriculture.

capital and livestock. Thus, the alternative rates of interest of 8 and 13

percent resulted in a varying "weight" assigned to land.

Although there is no apparent way of determining the net effect of the

above (or other) sources of error of measurement, the principal findings (as

to conformation of trends in productivity) would probably be maintained if

such errors could be eliminated.

V. <u>Factors Contributing to Changes in Measured Productivity</u>

Assuming that errors of measurement of the type cited above do not radically

affect the overall magnitude of changes in productivity or the configuration of

the trend for the period 1951-64, what can be said about the forces underlying

the observed changes in output and productivity. To recapitulate the main findings

in Sections II and III:

(a) The rate of annual increase in farm output in the USSR accelerated after

1953 to a peak output in 1958, followed by a decline in 1959, a levelling off in

1960, and new peaks in 1961 and 1965. A 3-year moving average (to dampen the

"weather effect") showed an average annual rate of increase of about 4 1/2 percent

for the 1950's (nearly 7 percent a year for the period 1954-58) followed by a

marked decline to about 1 1/2 percent per year for the first half of the 1960's;

(b) Except for the two-year period, 1954-55, when there was a spurt in use

of inputs of more than 5 percent a year, annual increases in conventional inputs

fluctuated between 1 and 3 percent;

(c) A comparison of trends in output and inputs shows that overall factor

productivity increased about 2 1/4 percent for the 1950's (nearly 3 1/2 percent for

the period 1954-58) followed by a slight decline in the first half of the 1960's.

Thus, all of the increase in output in the period 1961-64 can be explained by

additions of conventional inputs.

Although factors that account for the underlying changes in efficiency in

the use of resources are complex and not readily measurable, they can, nevertheless,

be identified conceptually. Some of the more important to be considered in the

Soviet setting are: (1) changes in the quality of labor services underlying the

physical measures of man-days and employment, (2) changes in the formal organ-

ization and management of agriculture affecting the efficiency with which resources

are combined, and (3) changes of policy in the use of land and livestock tending

to dampen or augment the flow of their service.

A. Quality of Labor Services

The measures used in this report for the input of labor (employment and

man-days) do not take into consideration possible variations in the intensity or

quality of work done. In the institutional setting of Soviet agriculture such

variations may result either from changes in the system of rewards and penalties

or in qualifications of the labor force. Changes in the quality of the labor

force are a function of the age and sex composition as well as the level of skills.

The latter, in large part, depends on the level of educational attainment, either

in occupational training or general education.

1. Changes in Incentives

Incentive arrangements in the collective farm system have varied

over the period covered in this paper and have presumably influenced the effort

put forth by the average participant in the labor force. 30/

30/ Even under the most favorable conditions, however, there is a tenuous connection
between effort and reward for the individual member of a collective farm. As
indicated above, the peasant is a residual claimant of the farm's income after
all other farm expenses have been met (including involuntary savings for future
investment). Moreover, the average payment per workday on the collective farm
is determined in such a manner that extra effort on the part of one individual
member is not apt to be commensurately rewarded.

In the period 1953-58 -- there were many incentive measures designed to induce

the collective farm peasant to contribute more days of participation in collective

farm work and a higher quality of labor service. The incentive measures adopted

included sharp increases (a tripling between 1952 and 1958) in commodity prices

paid collective farms and individual producers as well as abolition of compulsory

deliveries and tax concessions for private plot owners. The attitude of the

individual member towards participation in the work of the collective farm was

strongly influenced by the penalty for not contributing the compulsory minimum

number of days in collective farm work -- loss of his private plot. These

measures gave the peasant a rise in real income between 1953 and 1958 that

was relatively larger than the rise in real income of urban wage and salary

workers. (See Table 6).

Table 6
USSR: Real Wages Per Member of the
Collective Farm Labor Force
1953-63 a/
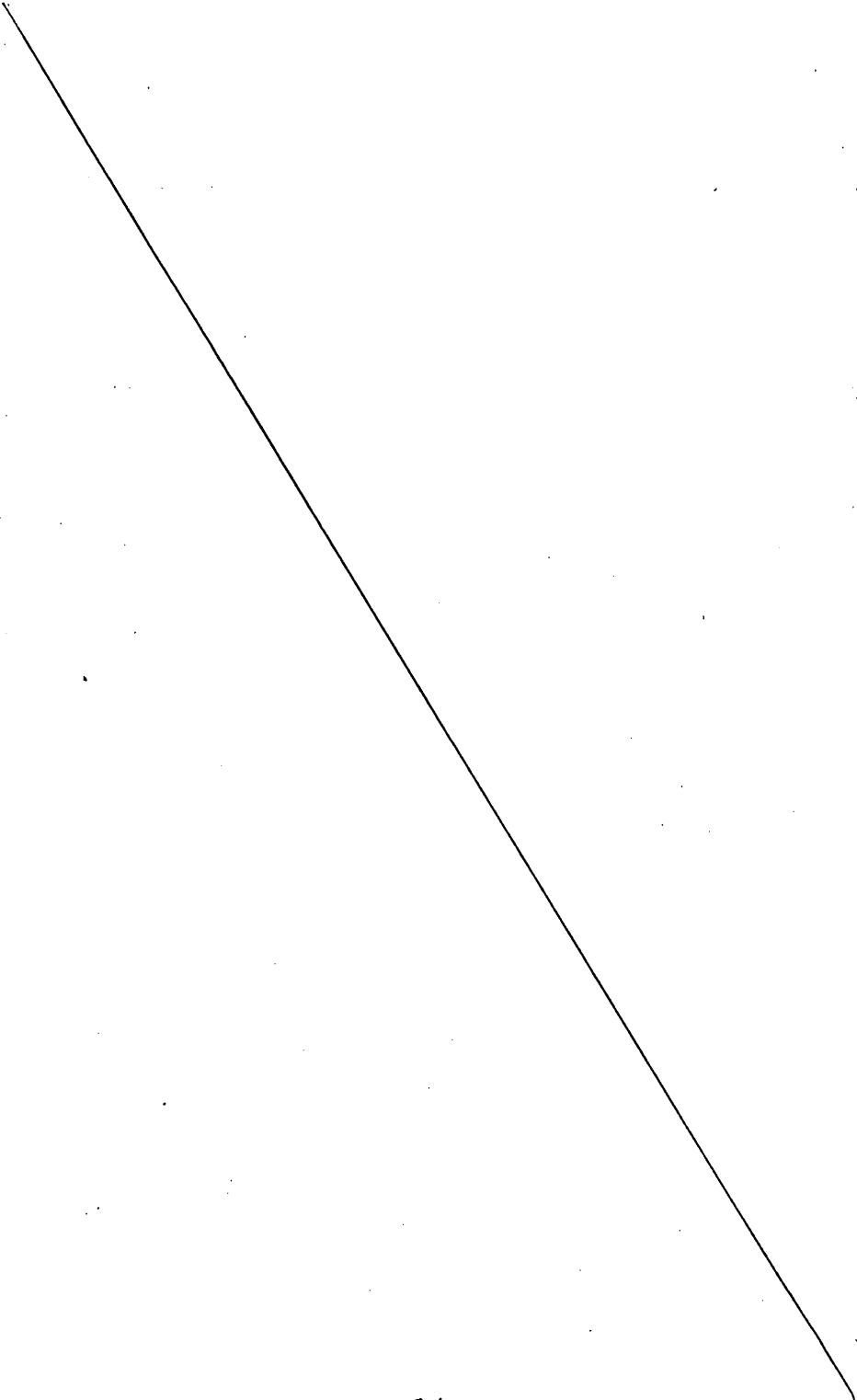
				1953 = 100
Year			Year	
1953	100		1959	194
1954	115		1960	183
1955	149		1961	224
1956	181		1962	224
1957	182		1963	232
1958	206			

a./ Source: Nimitz, op.cit., p. 97. The in-kind payments are valued in state
retail prices. Data in source are expressed in current prices and have been
deflated by use of a combined index of retail prices in state stores and col-
lective farm markets. Wages are for participation in collective farm work
only and exclude returns from other economic activity, e.g. work in the private
plot.

The marked increase in wages per man-day in the period 1953-58 undoubtedly

had a positive effect on the attitude of the collective farm peasant towards

work in the socialist sector, / already large disparity between average real
        But the evidence suggests that after 1958 the

wages for collective farmers and other groups has again increased. Accordingly,

there were increased indications that the tempo of out-migration of the

relatively more skilled workers increased. 32/

32/ The moderate up turn in collective farm wages after 1960 is in part spurious.
After 1958 the money share of earnings from collective farm work rose sharply
and payments in grain and other products declined. Adequate supplies of farm
products in the villages (e.g. grain for flour or for feeding livestock) in ex-
change for the increased money payments were often not available and a ruble
increase thus was not equal to a ruble value of physical product. Ibid., p. 100.

Concomitant with the sharp turning point in 1958 in remuneration for

collective farm work was a change in the official attitude towards private

agriculture, including the small holdings of land and livestock of households

attached to collective farms. Pressures were applied to reduce the average

size of private plots and holdings of livestock. This situation————————➤·

had the double effect of directly retarding growth in output and reducing the

incentive of the peasant to participate in collective farm activity so as to

have his "own enterprise." By 1960 the size of the privately sown acreage

and livestock holdings per household was about 14 and 8 percent, respectively,

less than in 1958 (see Table 7). After the fall of Khrushchev in October 1964

the new administration quickly announced its intension to relax the rules on

private holdings.

Table 7
USSR: Index of Average Size of Private Holdings
Per Collective Farm Household
1953, 1957-63

1953 = 100

Year	Sown Acreage	Livestock a/
1953	100	100
1957	102	132
1958	104	136
1959	102	130
1960	90	125
1961	91	134
1962	92	141
1963	N.A.	138

a/ Average of total cattle, hog, sheep, and goat inventories at beginning and end of year valued in base procurement prices of 1958. The coverage of households excludes about 2 percent of the number of households included in the acreage and livestock data.

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2. Changes in the Quality of the Labor Force

   a. Changes in Age and Sex Composition

   The flow of services from a farm labor force may vary over time due to changes in the age and sex composition. In some farm activities males and females are substitutes, in others, they are not. Similarly, there are many farm activities in which youths and oldsters lack the physical capability to undertake at all or are less effective than mature, able-bodied persons.

No ₰ ⟵ The man-day and employment measures used in this paper are not differentiated according to the age and sex of the individuals in the farm labor force and, hence, changes in composition overtime are not reflected in the index series.

   Estimates can be obtained for the distribution of the Soviet farm labor force between males and females for the following three age groups: youths, 12 to 15 years of age, the "able-bodied" ages (males, age 16 to 59, and females, age 16 to 54),and the over-aged.(see Table 8)

Table 8
USSR: Estimated Distribution of the
Farm Labor Force by Age and Sex
Selected Years, 1950-62 a/

						Percent
	1950	1953	1955	1958	1960	1962
By Age						
Youths, age 12 to 15	16	15	10	8	10	11
"Able-bodied"	74	73	77	73	69	66
of which						
Males, age 16 to 59	24	25	28	29	28	28
Females, age 16 to 54	50	48	49	44	41	38 .
Over-aged	10	12	13	19	21	23
By Sex						
Males (age 12 and over)	35	36	37	38	39	40
Females (age 12 and over)	65	64	63	62	61	60

a/ Source: Author's estimates (unpublished). Persons in households attached to socialized agricultural enterprises exclusively or principally engaged in farm activity either in the socialist enterprise or in their family's private holding.

Changes in the composition of the farm labor force between 1950 and 1964 are explained in part by structural changes in the population as a whole and in part by migration from agricultural to non-agricultural employment or vice versa. The evidence indicates only small to moderate changes in rates of labor force participation by each of the age groups.

The moderate increase after 1950 in the proportion of "able-bodied" males in the farm labor force reflects the slow recovery of the Soviet Union from its critical "male deficit." The losses during the two World Wars, the revolution, and the collectivization campaign of the early 1930's so decimated the male population that by 1950 there were only 60 males per 100 females in the Soviet population, 35 years of age and over. 33/

33/ James W. Brackett, "Demographic Trends and Population Policy in the Soviet Union," in Dimensions of Soviet Economic Power, op.cit., p. 519.

The cyclical variations during 1950-62 in the proportion of the farm labor force comprised of youths was primarily due to relatively high birth rates in rural areas between the end of the collectivization drive (1934) and World War II; depressed rates during the war; and recovery in rates in the post-war period. The sharp increase in the proportion of over-aged persons in the farm labor force is due in part to demographic changes common to the population as a whole and in part to selective immigration from outside of agriculture.

Because of the direction of these structural changes in age and sex of the labor force (see Table 8) a qualitative adjustment upward in the employment index shown in Table 5 would seem to be in order for this period. The rise in the

proportion of males, 16 to 59 years of age, and the decline in the share of

youths suggests that the average "physical" capability of the labor force

improved. Much of the increase in the share of oldsters during this period

was due to the growth in numbers of those just over the upper limit for the

able-bodied (age 54 for females and 59 for males); what they may have lacked

in physical ability as compared with youths was probably more than offset by

skills acquired through experience.

Similarly, a downward adjustment appears appropriate for the period

1958-62 to allow for the decline in the proportion of workers in the able-

bodied category. The lower average quality per member of the labor force

brought about by this decline in the share of able-bodied -- from about three-

fourths to two-thirds -- probably more than offset the gain due the slightly

higher proportion of males.

b. **Changes in the Average Level of Educational Attainment and Training**

Results of recent research on the sources of economic growth in the United States have highlighted the significance of the educational level of the labor force in explaining changes in productivity over time.

34/ Edward F. Denison, The Sources of Economic Growth in the United States and the Alternatives Before Us, Committee for Economic Development, Supplementary Paper No. 13. New York, 1962. Chapter VII.

Griliches, op.cit., p. 965

Griliches found that one-fifth of the increase in productivity of conventional inputs in US agriculture between 1949 and 1959 could be attributed to increases in the level of formal schooling of the farm labor force.

A major improvement in the educational attainment of the Soviet farm labor force took place between the census years of 1939 and 1959. Although benchmark data are not available for post-war years before 1959, the evidence indicates that most of this gain came in the years 1950-58. The fragmentary data for the period after 1959 suggest that in recent years the increase in educational attainment has slowed down (see Table 9).

Table 9
USSR: Indicators of Educational Attainment
of the Collective Farm Labor Force
Selected Years, 1939-64 a/

	Share of Total (Percent)				
Years of Schooling	1939	1959	1962	1963	1964
0 to 6.9	98	77	77	76	74
7 or more	2	23	23	24	26

a/ Source: Soviet statistical abstracts. Data are not available for level of education of the state farm labor force.

Enrollment in grades 5 to 7 at rural schools averaged 3.8 million pupils

per year during 1945-49, 8.1 million pupils during 1950-54, and 4.6 million

pupils during 1955-58. The spurt in annual enrollments in the early 1950's

reflected a combination of high rates of birth in the late 1930's and an

official campaign to expand enrollments after the fourth year of schooling.

The sharp reduction in annual enrollments in the following four years can be

explained by the depressed birth rates during the war and immediate post war

years. Given the two-year lag in the cycle of peak enrollments and initial

entry into grades 5 to 7, a relatively large influx into the labor market

of persons with at least 7 full years of schooling probably occurred in the

period 1952-56. 35/

35/ The majority of youths graduating from grade 7 would probably have been
14 to 15 years of age. The proportion of primary school graduates in rural
areas enrolling in secondary schools (grades 8 to 10)in the mid 1950's
appears to have been relatively low. In 1955-56 enrollments in grades
8 to 10 at rural schools amounted to 27 percent of enrollments in grades
5 to 7 three years previously (1952-53).

Similarly, the slow progress after 1959 in raising the proportion of the

collective farm labor force with 7 or more years of formal schooling was due

in part to the sharp decline in the average annual enrollments in grades 5

to 7 in the period 1955-60 and in part to an increase in out-migration par-

ticularly among the young with a relatively high level of educational

attainment. The above pattern of school enrollments, graduations, and out-migration
would bring about similar qualitative changes in the two sub-periods (1950-58 and
1959-64) in the labor force in both the collective and state farms.

Another indication of change in the qualifications of the farm labor force

between 1950-58 and the years following is the increase in the number of

professionally and vocationally trained personnel residing on farms ---

technicians (agronomists, zootechnicians, and veterinarians) and mechanics

and mach.ne operators. The number of technicians in agriculture grew rapidly

in the period 1953-57 under the impetus of post-Stalin programs aimed at

relocating agricultural specialists who had been trained but were employed in

non-farm activities. A levelling off in the number of specialists in 1958-60

was followed by a moderate increase in 1961-64, as shown in Table 10.

Table 10
USSR: Average Annual Rate of Increase in the Number of
Specialists and Trained Machine Operators and Mechanics on Farms
Selected Periods, 1950-64 a/

	Specialists b/	Machine Operators and Mechanics c/
1951-53	N.A.	7.9
1954-57	30.7 d/	8.1
1958-60	-0.1	3.4
1961-62	4.7	1.6
1963-64	2.6	5.2

a/ Source: Soviet statistical yearbooks, various editions.
b/ Agronomists, zootechnicians, and veterinarians with specialized secondary or higher educational degrees.
c/ Mechanics, tractor drivers, combine operators and truck chauffers. Engineers and the small number of persons whose sole classification is "mechanic" are excluded. The large majority of qualified mechanics are found among the persons classified as "machine operators."
d/ 85 percent of the increase in the number of specialists between 1954 and 1957 came in the two-year period 1954-55.

The large increase in parks of power machinery on farms in the period

1954-57 was matched by an equally large boost in mechanics and machine operators.

But as in the case of specialists there has been a slowing in recent years of

the earlier rates of increase in machine operators and mechanics trained in

vocational schools or on farms. As a result, the ratio of trained operators

and mechanics to the stock of power-driven machinery on hand has declined. The

following tabulation shows the number of trained operators and mechanics on

farms per unit of equipment (tractors, trucks, and grain combines) in

selected years:

Year	Operators and Mechanics Per Unit of Equipment
1950	1.25
1953	1.15
1957	1.13
1960	1.08
1964	0.98

In addition to the decline of average numbers of machine operators per unit of power equipment there has been an apparent decline in their average quality. This deterioration in quality is in part due to inexperience due to the high rate of turnover. For example, in state and collective farms of the Russian Republic in "recent years 84 tractor drivers left for every 100 new ones to arrive .... (this is) caused by shortages of housing ....and often by low pay for machine operators." As a result "the level of qualification is not sufficient. Two-thirds of the tractor drivers on state farms have a third-class qualification." 36/

36/ (Plenum Tsentral'nogo Komiteta Kommunisticheskoy Partii Sovetskogo Soyuza) 24-26 March 1965, Stenograficheskiy Otchet. p.111 · The third-class category includes only those drivers recently trained and with less than one year's experience.

The decline in the ratio of qualified operators per machine led to a reduction in services per machine and thus a lengthening of operations during critical periods of planting, cultivation and harvesting. Between 1960 and 1964 the average use of tractors per day of operation (e. g. acreage plowed) declined by 21 percent on collective and state farms (2.9 hectares to 2.4 hectares) and the average number of daily shifts per tractor during the period 1960-64 fell to 1.32 in collective farms compared to 1.46 shifts in 1957 in the defunct machine tractor stations. 37/ Thus, the lack of timeliness in field operations and the depressing effect on crop yields, a perennial problem in Soviet agriculture, may have worsened in recent years.

37/ (footnote follows on next page). -39-

37/ Ekonomika sel'skogo khozyaystva, no. 12, 1965, p. 20. The reduction in
average use of tractors and combines was also in part attributable to a
deterioration in the repair and maintenance of machinery discussed in Section
B, below.

B. Organization and Management

It is difficult to say whether the numerous reorganizations in Soviet agriculture since 1950 have engendered net gains or losses in efficiency or have had no effect. 38/

38/ There have been at least 11 major organizational changes in Soviet agriculture in the past 15 years. For a good account of the various organizational changes in Soviet agriculture during the Khrushchev era see:

CIA ER 63-23, Vacillations in the Organization of Soviet Agriculture, 1953-63, Washington, D.C., 1963.

Howard R. Swearer, "Agricultural Administration Under Khrushchev," in Soviet Agricultural and Peasant Affairs, op. cit.

Alec Nove, "Some Thoughts on Soviet Agricultural Administration," Soviet Agriculture: The Permanent Crisis, New York: Praeger, 1965

On balance, the frequent changes in the administrative structure and personnel of organizations directing farms from above probably disrupted the normal flow of decision making. But with the exception of one innovation (discussed below) the evidence is not persuasive that Khrushchev's long series of organization and management moves were any more disruptive in the period when factor productivity was declining (1961-64) than in the earlier periods. 39/

39/ The organizational changes after 1960 tended to weaken the position of the government bureaucracy and enhance the position of the party in directing farm activities. It could be argued that the latter were technically less qualified than the "technocrats" in the Ministry of Agriculture and other government bureaus and, thus, the quality of decision making in the recent period had deteriorated.

In any case, the new regime is anxious to give the world the impression that most of the problems besetting Soviet agriculture in recent years stems from Khrushchev's frequent innovations in management and organization. The following quote from P. Ye. Shelest, First Secretary of the Ukrainian Party, is typical:

> The subjectivistic (i. e. Khrushchev) approach to the solution of the most important questions in .... agriculture was manifested in the flagrant violation of the principles of planning, in sham administration, ... in many reorganizations that had not been thought through. All this even now is costing our country and particularly the collective and state farms dearly.

Plenum, op. cit., p. 36

These numerous and varied reorganizations clearly have not altered the essential characteristics of the management of socialized agriculture. Khrushchev, through

major innovations in agricultural administration, apparently tried to establish a

balance between central control and local autonomy in decision making. But he

failed in his attempts to partially decentralize the planning of farm produc-

tion in 1955 and 1964 by permitting farm managers to decide their own crop and

livestock production programs failed. 40/ In general, deviations from the

40/ This failure was explicitly acknowledged by K. Obolenskiye, Director of the
All-Union Scientific Research Institute of Agricultural Economics, Ekonomika
sel'skogo khozyaystva, no. 3, 1965, p. 8

traditional pattern of detailed direction of farm activity from above have been

unstable and have quickly resulted in reestablishment of central authority. Thus,

as in other areas of the economy, centralized planning and control have remained

the guiding principles.

In addition, the success criteria for managers of farm enterprises have remained

essentially unchanged. These criteria provide managers of farm enterprises with

little incentive to save on inputs. 41/

41/ For a good discussion of success criteria for farm managers, see Alec Nove
"Incentive for Peasants and Administrators," in Soviet Agricultural and Peasant
Affairs, op.cit., p. 51-68

The pay and bonuses of farm managers are keyed to the fulfillment of physical

production goals and government procurement plans. If the farm manager responds

to these "success indicators" he cannot simultaneously respond to other goals

such as "profits." 42/ The manager's non-monetary incentive is to please his

42/ The accounts of the collective farms do not show net revenues. Although
such accounts exist for state farms, up to 1965 the prices paid to state farms
were generally set at levels below those required to cover current ruble outlays
of most farms. Moreover, most capital investment funds for state farms are
provided as free grants from government budget sources.

superiors in the administrative hierarchy above the farm, especially that of

the Communist party; here again, he pleases when he gets out physical production;

cost considerations are secondary.

The evidence indicates that at least one of Khrushchev's major innovations

in agricultural administration -- the abolition of the machine tractor stations

(MTS) -- had a negative impact on factor productivity. The MTS system had

been established by Stalin to provide a pool of machines and machine services

for the collective farms. In 1958 Khrushchev proposed that the MTS be dismantled

and that most of their machinery and functions be transferred to the collective

farms. 43/ Many of the largest MTS were distributed to non-agricultural

_____

43/ In 1957 the average MTS serviced the needs of 10 collective farms.

_____

organizations and state farms. The remaining facilities which were either

assigned to collective farms or to a new network of government operated repair

technical stations (RTS), could not maintain previous standards of machinery

repair and maintenance. V. V. Matskevich, reappointed as Minister of Agriculture

in the wake of Khrushchev's removal, claims that as a result of the dissolution

of the MTS System, "the government repair base ... was shattered and repair

services (for collective farms) essentially eliminated." 44/ In Belorussia,

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44/ Voprosy ekonomiki, no. 6, 1965, p. 5-6.

_____

for example, in 1964 nearly one-half of the volume of repairs of agricultural

equipment was done by collective farms that "not only had no standard repair

shop nor even the simplest repair shop, but only smithies." 45/ At the same

_____

45/ Plenum, op.cit., p. 55.

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March Plenum the First Secretary of the Armenian Republic provided further

evidence:

> Experience showed that with the so-called reorganization of the machine-
> tractor stations a significant part of the repair base in fact was wasted
> and machine-tractor station buildings were changed into various warehouse
> facilities or at best were transferred to secondary needs of industry.
> For example, in the Armenian SSR after the liquidation of the machine-
> tractor stations, we managed to preserve only 35 of the 52 well-equipped
> standard repair shops existing before 1959. The others were transferred
> to various organizations ... All this was done in an unorganized and
> poorly thought out manner, as a result of which agricultural production
> suffered enormous damage. 46/

46/ Ibid., p. 217.

Moreover, the decentralization of the repair facilities of the MTS
apparently led to the loss of important economies of scale. In Tambov Oblast,
the "cost of capital repairs of tractors during recent years has more than
doubled in comparison with the cost of repairs in the MTS." 47/

47/ Ibid., p. 76. Part of this increase in cost could be attributed to a
large increase in prices of purchased spare parts.

C. Policies Affecting the Use of Land and Livestock

    1. Expansion of Numbers of Livestock in the Socialized Sector

The propensity of Soviet planners to increase the size of livestock herds irrespective of the availability of feed supplies has probably contributed to the decline in growth of factor productivity in recent years. Because of the relatively low availability of feed per head of livestock in the Soviet Union a high proportion of feed must be used for the maintenance of herds rather than for production of milk, meat and other products. [48] Under these

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[48] If a cow produces only 1,000 kilograms of milk per year about three-fourths of the feed consumed is required for maintenance; but if output increases to 1,500 kilograms, only two-thirds of the feed consumed goes for maintenance. Johnson in Economic Trends..., op.cit., p. 230.

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conditions, if the number of livestock were to remain unchanged, the value of an additional unit of feed in terms of output of products would increase the average value of output per unit of all feed.

Milk output per cow in collective farms, for example, doubled between 1953 and 1959 due in part to increased quantities of feed per head and in part to improvements in the quality and a change in the seasonal distribution of feed. Khrushchev's program for a rapid expansion of corn acreage led to a three-fold increase in silage over the period 1953-59, thus providing a valuable qualitative addition to the feed ration. [49] The continued expansion

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[49] See D. Gale Johnson and Arcadius Kahan, "Soviet Agriculture: Structure and Growth", Comparisons of the United States and Soviet Economies, Joint Economic Committee, U.S. Congress, Washington, 1959, Part I, p. 219-20.

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of herds of livestock after 1959 in the face of stagnating or more slowly growing output of feed, however, resulted in lower efficiency in the use of feed and contributed to a lower rate of growth in the factor productivity. The

following relevant data are available for cows held by collective farms:

Table 11
USSR: Indexes of Numbers of Cows, Average Annual Milk Production,
and Feed Per Cow in Collective Farms, 1958-62 a/

	1958	1959	1960	1961	1962
Total numbers	100	109	110	111	119
Milk output per cow	100	103	96	91	87
Use of feed per cow					
Grain and other concentrates	100	117	101	73	48
Silage b/	100	115	110	111	98
Hay	100	97	78	70	64

a./ Source: Finansy SSSR, no. 4, 1964, p. 12.

b./ Includes silage and other succulent feed, such as potatoes, feed roots, and sugar beets.

The same conclusion emerges from data that show change in the total stock of animals and total outlays of feed in state and collective farms for the benchmark year 1953 and the period 1958-64. The fact that livestock numbers after 1958 rose at a faster rate than feed availabilities not only signalled an absolute decline in milk output per cow, but probably also declines in meat and other animal products per ruble of livestock inventories.

	Index of Livestock Inventories a/	Index of Total Feed Expenditures b/	Feed Expenditures Per Unit of Livestock
	(1958 = 100)		
1953	80	75	94
1958	100	100	100
1959	113	108	96
1960	124	111	90
1961	134	112	84
1962	145	112	77
1963	138	100	72
1964	131	98	75

a./ Cattle, hogs, sheep, and goats on collective and state farms.   Index of inventories reflects the mean of herd values (all ages)at beginning and end of year.

b./ (footnote follows on next page)

b. Feed expenditures expressed in total feed units as officially reported in Soviet statistical yearbooks (various editions). The data before 1961 excluded the feed obtained from pastures. Since the contribution of the latter to total feed supplies remained nearly the same in the period 1961-64, it was assumed that the absolute level of pasture supplies in 1961 remained the same for the period 1959-61. Pasture conditions were exceptionally good in 1958 and thus the feed units obtained from pasture for that year are roughly estimated at 30 percent above the 1959-61 level. There are indications that in 1953 pastures contributed roughly the same magnitude of feed units as in 1961.

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2. Crop Policies

Dramatic changes in the use of land for current or future production

of crops have occurred over the past decade in the USSR. Although the impact of

these changes cannot be evaluated in detail here, a summary appraisal can at

least point the direction of their impact on overall factor productivity. 50/

50/ For a brief but good description of several land use programs see Willett, op. cit. For a more detailed and critical survey see Naum Jasny, Khrushchev's Crop Policy, Glasgow, 1965.

In a series of programs inaugurated between 1954 and 1962, Khrushchev

directed an expansion of more than 60 million hectares in sown acreage and

a radical restructuring of crop patterns. 51/ The "new lands" campaign,

51/ This expansion of acreage constrasts sharply with an increase of less than 40 million hectares over the previous 40 years (1913-53; on comparable territory).

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initiated in 1954, was quickly followed by an even more ambitious "corn program"

in 1955. The former program resulted in the plowing up of some 42 million hectares

of virgin and long-fallowed lands, mostly in Kazakhstan and Siberia. The "corn

program" expanded the acreage of corn for grain, silage, and green feed from

to a peak of 37 million hectares in 1962.
4 1/2 million hectares in 1962./ When the effects of these two programs on output

began to taper off, Khrushchev initiated yet another program, the "plow-up"

campaign of 1962. The latter was designed to shift the cropping pattern radically,

principally through a drastic reduction in the area sown to perennial grasses and

a restriction of the practice of clean fallowing.52/   The newly released

52/   Under the practice of clean fallowing the land is not planted and is cultivated only as needed to prevent growing of weeds.   The practice also permits accumulation of moisture in the soil,

acreage was to be put under cultivated crops.

    The first two major innovations in land-use -- the new lands and corn programs -- had a favorable short-run impact, promoting sizeable increases in output and productivity, but by the end of the 1950's the impact had tapered off, and the evidence indicates that in the early 1960's the new lands program even had a detrimental effect on output and productivity.   These deleterious effects stem from the fact that in an effort to obtain additional amounts of "cheap" grain, Soviet planners -- at Khrushchev's behest -- ignored certain farming practices essential to maintaining yields in the new lands regions. Much of this area is comprised of marginal and sub-marginal soils subject to frequent droughts; good land management in analogous areas of North America (mostly the Prairie Provinces of Canada) demands that 30 to 40 percent of the cultivated area be in clean fallow.   But the practice of fallowing was largely ignored in the new lands and by 1963 only 5 percent of the cultivated area was under fallow.   Continuous cropping has resulted in the deterioration of the structure of the soil, heavy infestation of weeds, a decline in fertility, and a depletion of reserves of soil moisture. 53/   Although the available

53/   Kommunist, no. 4, 1953 p. 64,

information is inconclusive, the above practices have apparently brought about
     ward
a down/trend in the yields per hectare of grain in the new lands as shown in

Table 12.

Table 12
USSR: Estimated Production of Grain from the "New Lands"
1954-63 a/

Year	Area Sown to Grain (Million Hectares)	Yield of Grain (Centners per Hectare)	Production of Grain (Million Tons)
1954	4.3	10.5	4.5
1955	18.5	4.3	8
1956	26	9.6	25
1957	26	5.0	13
1958	26	8.8	23
1959	23	7.0	16
1960	26	6.9	18
1961	26	5.8	15
1962	25	6.8	17
1963	25	4.0	10

a/ Source: CIA, ER 64-33, The Production of Grain in the USSR, October 1964, p. 17.

In the 5-year period, 1959-63, grain yields in the new lands (as estimated by

CIA) averaged 6.1 centners per hectare compared to 7.6 centners in the previous

5-year period.

On balance, the corn program proved successful, but the levelling off of

acreage in areas in which corn is reasonably well adapted and the expansion in

areas unsuitable for corn brought about a levelling off of the program's contri-

bution to output at the end of the 1950's.[54] Moreoever, the peak seasonal needs

for labor and machinery in cultivating and harvesting of corn overlaps the peak

seasonal needs of other crops. The failure in recent years to maintain earlier

rates of increase in tractors and other types of field equipment combined with

the overall reduction in the size of the labor force has put a strain on re-

sources in major corn-growing regions. Thus, yields of corn and other crops with

which corn competes in timeliness of field operations may have been adversely

affected.

54/ See footnote page 50

54/ For example, harvesting of hay in late spring and early summer, fall plowing for spring sowing of small grains and fall seeding of winter wheat. For an appraisal of the corn program in the 1950's see Johnson in Economic Trends..., op.cit., p. 228.

The third major innovation in land use -- the "plow-up" program -- was intended to replace "low yielding" crops (sown grasses and oats) and fallow with "high yield" crops (peas, beans, and sugar beets). The program, announced in October 1961 and two-thirds completed during 1962, was roughly comparable to the new lands campaign in its requirements for additional manpower and machinery. Unlike the case of the new lands, however, the additional resources were not provided and there is no evidence that a significant increase in net output per hectare occurred. Moreover, abandonment of the grass rotation system in the Northern USSR -- a key part of the program -- may have resulted in serious depletion of soil nutrients because the use of additives (fertilizer and lime) was not expanded enough to replace the nutrients previously contributed by sown grasses. In the March 1965 Plenum of the Central Committee several speakers explicitly condemned the plow-up program as "damaging" and "disruptive" to livestock raising because fodder supplies were depleted both by the reduction in perennial grasses and by lower crop resulting yields from "violation" of crop rotations. 55/

55/ Plenum, op. cit., especially pp. 115, 170-172, and 220-221.

Appendix A

DERIVATION OF THE INDEX OF SOVIET AGRICULTURAL OUTPUT

A. Sources of Data

1. Coverage

The index shown in Table 1 of the text is based on the quantities

available for sale and home consumption of : grain, potatoes, vegetables,

cotton, sugar beets, sunflower seed, flax fiber, meat, milk, wool, and eggs.

In addition, changes in livestock inventories that may be hold for investment

purposes are included. The weights used in aggregating these quantities are

state procurement prices established for collective farms in 1958. For

purposes of productivity accounting it would be appropriated to include in

the concept of output changes from year to year in the inventory of farm

commodities (including feedstuffs). Such data are available for socialized

farms for selected years but are expressed in current ruble values aggregated

in such a manner that deflation into "constant 1958 prices" is not feasible.

Changes in stocks of farm commodities held by the Government are not published.

2. Gross Output Data

The official series for production of the above eleven commodity and

livestock inventories are available for 1950-64 from the following official

statistical yearbooks:

TsU, Sel'skoe Khozyaystvo SSSR. Moscow, 1960.

TsU, Narodnoye Khozyaystvo v 1964. Moscow, 1965.

For 1965 from:

TsU, SSSR v Tsifrakh v 1965. Moscow, 1966.

Official data on the gross production of the following products have been

accepted without adjustments: potatoes, cotton, flax fiber, wool, and eggs.

The derivation of the production estimates for the others is as follows:

    a. <u>Grain</u>

       <u>1950-55, 1957</u>: Official data for gross output (excluding corn

in the milk-wax stage) are accepted.

       <u>1956, 1958-65</u>: Independently derived estimates as follows:

Year	Official	Estimated
	(millions of metric tons)	
1956	125.0	112.5
1958	134.7	119.0
1959	119.5	95.7
1960	125.5	93.0
1961	130.8	109.5
1962	140.2	109.0
1963	107.5	92.0
1964	152.1	120.0
1965	120.5	100.0

The deduction for 1956 is a rough estimate of the excessive post-harvest

losses resulting from inadequate transportation and storage facilities in

the new lands areas to handle the bumper crop produced.

    As was noted above, Western analysts are in general agreement

that Soviet agricultural statistics have become increasingly unrealiable

since 1957, especially in official claims of production of grain. One

source has this to say:

        Beginning with 1958, Soviet officially reported annual
      yields of grain, especially wheat and corn, have been considerably
      higher than yields for any other year in Soviet history. In
      addition, reported yields have shown a stability that is uncommon

to any previous known period of comparable length and that
seems to conflict with the fluctuations that would be
expected from the dissimilar weather conditions in the
individual years......

A new estimating procedure apparently was introduced
in 1958. Instruction No. 1684 of the Central Statistical
Administration, dated 23 April 1958, includes information
on the method to be used in estimating the grain crop.
This instruction apparently has not been published for
public dissemination.

(CIA, ER 64-33, Production of Grain in the USSR, October 1964,

p. 20, 22).

Because official production claims are so inflated independent

estimates are obtained in the following manner:

In estimating the actual amount of grain harvested
in a given year, Western analysts use data on grain
acreage and its distribution among kinds of grain and
regions. Estimates of yields per hectare are based on
reports on weather and the condition of the grain crop at
various times during the season; on the progress in seeding
and harvesting; on the amount and progress of grain procure-
ments in the various administrative subdivisions; on
statements made by Soviet officials; and on a qualitative
consideration of changes in inputs (such as machinery,
fertilizer, and seed) that would affect the grain harvest.
Estimates are made of the yield of each of the major kinds
of grain in the various regions of the USSR, and these
estimates are compared with figures obtained for earlier
years when crop and weather conditions in the different
regions were similar to those prevailing in the year in
question. These yields then are applied to the data on
grain acreage in arriving at estimates of production of the
various kinds of grain and consequently the total grain
harvest. (Ibid. p. 15-16).

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The above summarizes the approach used in deriving the estimates for gross

grain output for the years after 1957. As the above report notes, a check

on grain production estimates by estimating utilization "provide inconclusive

results because the great number of estimates required in the calculations"

(Ibid. p. 16) (waste, industrial uses, net exports, seed, feed, food and

change in stocks). However, the fact that in recent years the Soviet Union

has been a major net importer of grain (11 million tons after the poor 1963

harvest and contracts for another $7\frac{1}{2}$ million tons after the mediocre 1965

harvest) provides adequate evidence that large stocks of grain have not been

accumulated. This and other evidence on utilization provide benchmark

indicators and give some assurance that the production estimates are

reasonably accurate.

b. Sunflower Seed:

1950-57: Official data for gross output are accepted.

1958-64: Production claims have been reduced by about 8 percent

to allow for the excess moisture and trash that results when "bunker weight"

(i.e., as measured in the harvesting machine) instead of "barn yield" is

used in determining the size of the harvest. The discount used is that

required for the year 1958 (Ekonomika Sel'skogo Khozyaystva, no. 6, 1959,

p. 32). The 1964 statistical yearbook (Narkhoz. 1964, p. 316) indicates

that "bunker" estimates have been used for all years since 1950. For

present purposes a flat 8 percent is used only for the period 1958-65

although it also may be appropriate to discount for earlier years, and

although the annual required discount may fluctuate from year to year to

an unknown extent.

c. Sugar Beets:

Official data on state procurements of sugar beets are used in

place of gross production. It is assumed that sugar beets not procured by

the state are fed to livestock or are used in production of seed.

d. Meat:

Official production data (including fat and offal) have been

adjusted by reductions of 10 percent for the years 1950-56, 11 percent for

1957, and a range of 12 to 15 percent for the period 1958-65. These

represent notional allowances for assumed padding of official statistics.

Under the pressure of Khrushchev's campaign for "catching up" with the

United States in meat and milk output (initiated in 1957) it is believed that

pressures on reporting officials at various levels to fulfill unrealistic

goals led to a greater degree of falsification in years after 1956.

e. Milk:

Official production data minus a deduction of 5 percent for

1950-56 and a variable rate of 6 to 10 percent between 1957-65. See note

above for meat.

f. Changes in Inventory of Livestock:

1950-62, 1964-65: Changes in inventory of livestock are

estimated by changes in the number of cattle, hogs, sheep, and goats at

the end of the given year in comparison with numbers at the end of the

previous year. No allowance is made for changes in average value per head

due to differences in average weight or other indicators of productivity.

1963: The major shortfall in grain output in 1963 provided the setting for a major reduction in numbers of productive livestock, especially hogs, between the end of 1962 and the end of 1963 (hog numbers declined more than 40 percent). Changes in the number of livestock in 1963 undoubtedly resulted from slaughtering young animals or animals of very light weight and foregoing the breeding of livestock. Thus it is not appropriate to weight this decline in numbers by the usual method of applying the value of animals of average size purchased by the state during 1953-59.

The method of determining the value of the decline in the number of livestock in 1963 is as follows. On the basis of the past relationships between the number of meat-producing animals at the beginning of the year and production of meat during this year, production of meat for 1963 was projected at 8.53 million tons (9.93 billion rubles). Assuming that the value of the meat produced in excess of this amount was equal to the value of the decline in the herd, the following value of net agricultural production is derived.

Item	1962	1963
	Billion Rubles	
Meat	9.47	9.93
Livestock	1.00	0
Other components	20.31	19.27
Total	30.78	29.20

3. Use of Production for Feeding of Livestock

a   Grain and Potatoes

Estimates of utilization of grain and potatoes as feed were based on a number of considerations:

(1) net availabilities after deductions for other uses (industrial use, food net exports, change in stocks);

(2) food requirements implicit in the level of meat and milk output;

(3) scattered official evidence on total amounts fed for certain years or per head rates of feed utilized.

In making the needed deduction from the gross value of livestock for the value of grain and potatoes fed it was assumed that one-third of the grain used as feed from a given crop will be fed during the calendar year in which it is produced or during the period 1 July - 31 December and and that two-thirds will be fed during the following calendar year or during the period 1 January - 30 June.

b. Milk

A flat deduction of 10 percent was made in the adjusted milk series as an allowance for feeding to livestock.

4. Use of Production for Seed

a. Grain

The amount of grain deducted for seed in a given year was estimated at 0.15 ton per hectare of the area sown to grain for harvesting in the following year. (Pravda, 11 Feb 64. and Entsiklopedicheskiy sel'skokhozyaystvennyy slovar'spravochnik, Moscow, 1959, p. 68, 408, 547, 703, 738, 1020.)

b. Potatoes

The amount of potatoes deducted for seed in a given year was estimated at 1.9 tons per hectare of sown area for harvesting in the following year. (S.A. Il'in, Ekonomika proizvodstva kartofelya. Moscow, 1963, p. 3, 5).

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5. <u>Price Weights Used in Aggregating Quantitative Data</u>

Official purchase prices of 1958 were used as weights. These were established in 1958 by the government as base prices for collective farms from which actual procurement prices were to fluctuate. The new official prices were supposed to provide enough gross receipts for farm outlays for both current expenses (labor, materials) and investment goods (machinery, buildings). This attempt to establish "full cost" prices for collective farms was largely due to the abolition of the machine-tractor stations in 1958 which previously had provided machinery services to collective farms at nominal cost.

Because farm output lagged after 1958, further major adjustments in prices followed in 1962, 1963, and 1965. The 1958 prices had failed to generate enough gross income to cover additional investment needs and to provide a boost in lagging farm wages. Large increases in prices were adopted for livestock (1962 and 1965); cotton, sugar beets, and potatoes (1963); and grain and milk (1965). If it is assumed that the relative prices for, say, 1963 and 1965 better reflect the needs (planners preferences) and costs (relative scarcities), and thus the appropriate rates of substitution among the products, it can be argued that they would provide a more appropriate set of weights in computing a net index of production. But despite the rather dramatic shifts in commodity prices between 1958 and 1965 the use of price weights for 1963 and 1965 had relatively little impact on the overall index of net production as shown in Tab. 13.

Table 13

USSR: Indexes of Net Agricultural Output Computed by Use
of Alternative Price Weights, Selected Years, 1950-65

(1950 = 100)

	Total Output			Livestock			Crops		
	A	B	C	A	B	C	A	B	C
1950	100	100	100	100	100	100	100	100	100
1955	126	124	125	137	143	141	119	112	113
1960	150	146	149	184	191	186	124	120	120
1965	171	167	172	212	221	220	141	135	135

A - 1958 base prices.
B - 1963 actual prices.
C - 1965 base prices.

The moderate acceleration in the index of output of livestock products due

to the change in relative prices after 1958 is offset by the dampening of

the index of output of crops by use of the latter sets of prices. In

addition there is close agreement among the three times series in turning

points, especially those computed with the 1958 and 1965 price relatives.

B. Divergence of the Net Index Based on the Above Estimates of
    Production from the Index Based on Acceptance of Official
    Production Data.

If above noted adjustments are made in the official gross production

data for milk, meat, sunflower seeds, and grain for the years 1950-65 the

average absolute level of production for each year in the period 1958-65 is

48 percent above the average absolute output for each year in the period

1950-55. If unadjusted gross output data are accepted the average

differential comes to 59 percent -- approximately one-fifth larger. To

test for the impact on the overall change in absolute level of output

resulting from the adjustments in the non-grain commodities (meat, milk,

sunflower seed) a comparative calculation was made by accepting the official

claims for the latter crops. The average increase in absolute output for

each year in the period 1950-55 (compared to the average for each year in

the period 1950-55) was 51 percent, suggesting that about three-fourths of

the difference between the adjusted and unadjusted series is due to

discounting of official claims for grain output; one-fourth to discounts

in the official data for the other three commodities (meat, milk, and

sunflower seed).

Appendix B

Derivation of an Index of Soviet Agricultural Inputs

Detailed exposition of the derivation of the data underlying the several

indexes of inputs is not possible in this paper. This appendix describes

briefly the concepts and coverage of the individual series on which the

indexes of inputs are based and explains the procedure for obtaining the

factor-share weights for 1959 used in combining the individual series into

an index of total inputs. The individual value and "physical" series from

which the volume indexes in Table 3 were derived are shown in Table 14.

A. Labor Input

Alternative series have been constructed for the labor input based

on: (a) the number of persons principally or exclusively engaged in farming

activity, and (2) the actual expenditure of work-days in agricultural

production (conventionally expressed in Western literature as "man-days").

The labor force series is based on relatively reliable data; the man-day

estimates are less reliable, especially that part reflecting inputs of

days in the private sector.

1. Numbers Principally or Exclusively Engaged in Farming Activity

The concept of agricultural employment used in this paper includes

persons 12 years of age or over who are principally or exclusively engaged

during the year in farm activity, except for members of households whose

head is principally or exclusively engaged in non-agricultural activities.

The latter provision is designed to eliminate from the employment count

those members of households whose only or principal employment consists of

USSR: Indicators of Resources Available to Agriculture
Expressed in Ruble Values or Physical Units a/
1950-64

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964
Capital Stock b/ (billions of rubles -- 1955 prices)	10.15	11.25	12.40	13.60	14.85	16.65	18.95	21.25	23.70	26.35	29.00	31.50	34.75	38.95	43.85
Land Input c/ Annual sown acreage (millions of hectares)	146.3	153.0	155.8	157.2	166.1	185.9	194.8	193.7	195.7	196.3	202.0	204.6	216.0	218.5	212.8
Index of weighted yields (1950=100)	100.0	100.6	100.7	101.0	100.1	99.3	98.7	98.9	98.9	99.1	97.5	97.8	98.6	96.7	97.0
Weighted acreages	146.3	153.9	156.9	158.8	166.3	184.6	192.3	191.6	193.5	194.5	197.0	200.1	213.0	211.3	206.4
Current Purchases d/ (billions of rubles -- 1959 prices)	2.59	2.85	2.90	3.58	3.76	3.95	4.10	4.39	4.77	5.00	5.26	5.72	6.18	6.78	7.22
Productive Livestock e/ (billions of rubles -- 1955 prices)	8.25	8.65	9.05	9.35	9.95	10.80	11.60	12.45	13.35	14.00	14.20	14.50	15.15	15.45	15.45
Labor f/ Man-days (millions)	10,619	N.A.	9,627	9,866	10,123	10,662	10,691	10,462	10,437	10,408	10,004	9,941	9,932	9,630	9,693
Number of persons principally engaged (thousands)	41,054	39,457	38,280	38,054	37,579	38,180	38,785	39,308	41,468	40,674	39,013	38,548	39,422	38,759	38,963

a/ The data in this table represent the underlying ruble values or physical units presented in Table 3 as indexes. Because of rounding of the data in this table the implied index numbers (1950=100) may not be comparable to those shown in Table 3 (computed from unrounded data).
b/ Includes value of fixed assets (machinery, buildings and other structures, land improvements such as irrigation and drainage) and value of draft livestock. Values are expressed in prices of 1 July 1955 with subsequent adjustments.-- mean of beginning and end of year values.
c/ Sown acreage in each year for each of 25 regions weighted by the average grain yield for each region in 1949-58.
d/ See text for categories of purchases included.
e/ See text for description of types of livestock included.
f/ Labor used in farm activity only. See text for discussion.

work on the "plot" (kitchen garden and/or small holdings of livestock) held by a household <u>not</u> attached to an agricultural enterprise in the socialist sector (or as an independent peasant) but whose family maintains a kitchen garden and/or holding of livestock as a <u>secondary</u> source of income.

<u>Members of households attached to agricultural enterprises</u> (collective and state farms and other state agricultural enterprises) whose head is <u>principally</u> engaged in <u>non-farming</u> activity (capital investment activity, municipal services, or subsidiary industrial production) are <u>included</u> if <u>their principal</u> occupation is in farming.

The requirement for inclusion in the farm labor force count is rather lax; only a nominal participation is required in terms of days per year. The coverage is more in keeping with the concept of "work experience" as enumerated by the U.S. Bureau of the Census. The concept used since 1940 for the farm labor force in the United States counts family members in farm households as participants only if they work 15 hours or more in a family farm during the "census week".

2. <u>Man-Days</u>

A series of total days worked in farm activity in the USSR was derived for all years in the period 1950-64 except 1951. It represents a measure of the volume of time spend directly in production of agricultural products -- crops and livestock -- and in associated administrative activities. The days are undifferentiated as to the age and sex of the persons employed. The coverage includes not only time worked by the persons included in the employmen series shown in Table 14 but also embraces the input of days by

persons of households whose head is <u>principally engaged in non-agricultural activities</u> but who maintains (in non-agricultural enterprises) small holdings (kitchen garden and/or small holding of livestock). Also included are days worked in farm activity by members of households <u>attached to agricultural enterprises</u> with a <u>principal occupation in a non-farm production activity</u> (e.g., capital repair, municipal service) but who have a secondary source of employment in farm production activity.

B. <u>Capital Stock</u>

The ruble series for capital stock is comprised of two components: (1) value of fixed reproducible assets, and (2) value of draft animals.

1. <u>Fixed Assets</u>

Official Soviet index numbers for agricultural fixed assets are available for 1928, 1940, 1952-53, 1958, and 1960-64. The ruble values underlying the index series are said to have been computed in "comparable prices" undepreciated and net of retirements. To get the series used in this paper, the ruble value of fixed assets at the end of 1962 was officially estimated, category by category, in 1955 prices. This base figure was then moved by the official index number series. Values for missing years were interpolated by use of official investment data (also in 1955 prices) and implicit retirement rates. The national census of capital stock in state sectors of the economy as of 1 January 1960 and a comparable census of collective farm assets as of 1 January 1962 have caused some adjustments in the official index series.

Detailed descriptions have been published of the inventory and revaluation of capital in the censuses of 1960 and 1962. Nothing is known, however, about the method used in obtaining the index series (undepreciated and in "comparable prices") used to extrapolate the benchmark values of fixed assets. As an independent check on the reliability of the official index, an index of machinery inventories was constructed and combined with an independently constructed index of buildings and other structures. The machinery index was computed for the years 1928-40 and 1950-59; the sample of machines weighted by prices of 1 July 1955 probably included 90 percent of the value of agricultural machinery and equipment during the two periods. Similarly, a rather crude measure of the value of the other major component of productive capital in agriculture -- buildings and other structures -- was obtained for the terminal years 1928 and 1959. Basic to the derivation of the index of structures is the use of the official investment series (expressed in prices of 1 July 1955). The independently constructed indexes, of stocks of machinery and structures were weighted by the relative shares of each in the total asset structure of agricultural enterprise at the end of 1962. The results of the exercise are compared with the official index of capital stock, excluding livestock:

Computed	Index of Capital Stock in Agriculture (1928=100)
Machinery	728
"Productive" Structures	514
Structures and Machinery Combined	657
Official	
Structures and Machinery Combined	623

-65-

The differential in the indexes comes to about 5 percent and
seems to be a reasonable, albeit rough, check on the official volume indexes
of fixed assets published in the annual statistical abstracts

2. Index of Draft Animals

The
/Value of draft animals (horses, oxen) at the end of 1962 of 1.1
billion rubles (1955 prices) was moved by the inventory of horse numbers
at the end of each year. The benchmark value in 1962 is equal to the value
of draft livestock held by socialized enterprises of approximately 1.0
billion rubles plus 0.1 billion rubles as an estimate of the value of
draft animals held by the private sector.

C. Purchase of Materials

The index of current purchases of materials from other sectors of
the economy is comprised of five series: (1) fuels and lubricants, (2)
current repairs of machinery and buildings including repair activity carried
out by the farms on their own account (3) use of electric power for
productive purposes (4) deliveries of fertilizer and (5) production of
processed feeds (millfeed, oilcake) by industry.

1. Fuels and Lubricants

The index of fuels and lubricants for 1950-56 was obtained by
estimating the quantities of each fuel and lubricant used for tractors and
combines and weighting them by use of regional delivery prices of 1 July 1955.
The index for 1950-56 was extrapolated to 1964 by use of an index of total
mechanical power on farms expressed in horsepower units.

2. Current Repairs

The index for current repair outlays is based on the estimated series of outlays on fuels and lubricants. Reasonably reliable estimates of actual ruble outlays (expressed in current prices) for current repairs are available for 1950, 1955-58, and 1962. When crudely constructed price indexes are used to deflate the current ruble series the implied "constant price" index appears generally consistent with the movement of the index based on the use of petroleum products. Accurate data are not available on the rather substantial changes in prices of spare parts and other repair materials and on wage rates of repair workers. These data would be necessary to obtain reliable deflators for the current ruble expenditures in selected years.

3. Fertilizer

Data on deliveries of nitrogen, potassium, phosphorous, phosphorous meal, and several minor fertilizers (expressed in standard nutrient content) were aggregated into a total index by use of factory prices (f.o.b.) prevailing for each type of fertilizer in 1958-59 plus estimated average delivery cost per type of fertilizer from station to user.

4. Electric Power

This series is based on the consumption of electric power (expressed in kilowatt-hours) for productive purposes. Electricity used for home lighting on farms and other "nonproductive purposes" is excluded.

5. Feedstuffs Purchased

The index is based on estimated production of millfeed (net of losses) obtained from the milling of small grains and pulses and production of oilseed cake obtained from cotton and sunflower seed. These series were aggregated by use of 1958 prices paid by collective farms. Production used in constructing the series is limited to materials processed in government-operated facilities. All such production of millfeed and oilcake is assumed to be used for domestic feeding of livestock. Excluded from consideration are inter-farm transfers of whole grain and other feedstuffs that result from the re-sale of government procurements to farms. These purchases were counted as intra-agricultural sales and were deducted in computing net output, as explained in Appendix A.

6. The Overall Index of Material Purchases

Indexes for the above five series of goods and services purchased from other sectors were available for 1950, 1953, 1955-64. The series for 1951-52 and 1954 were interpolated from adjoining years by use of the index of estimated outlays on petroleum products. The separate series were aggregated by use of the actual expenditure weights for 1959 (see Appendix C, below). The weight used for fertilizer was the actual expenditure by agriculture for all chemical products (pesticides, herbicides, paint products, etc., as well as mineral fertilizers). The non-fertilizer elements are minor when expressed as a share of total outlays for chemical products.

D. <u>Land</u>

The measure for land is the change in sown acreage in each of 25 regions weighted by average grain yields in each region for the period 1949-58. As noted in the text the similar characteristics with respect to climate and soil of most of the sown acreage in the Soviet Union leads to a relatively small change in weighted yields regardless of the major overall expansion and shifts regionally in sowings during the past decade. Moreover, grain yields in the areas that are rather sharply differentiated in climate and soil conditions (Northern European Russia and the Transcaucasus) from the major agricultural regions are not significantly different from those prevailing in the major areas. As a result the weighted average yield moved narrowly, the high for the fifteen year period coming in 1953 (8.65 centners per hectare) and the low in 1963 (8.28 centners per hectare).

E. <u>Livestock</u>

The measure reflects the value of productive livestock (excluding draft animals) held as breeding stock or for purposes of producing a flow of services over a series of year (e.g., dairy cattle for milk, sheep for wool). The portion of the herds that is comprised of young stock before the reproductive age or animals raised solely for slaughter is excluded. The value of such livestock are included as working capital in official accounting procedures.

Appendix C

II. Index Formula and Selection of Weights

    A. Choice of Index Formula

        The several inputs considered are aggregated into a production function

of the following form:

(1) $Q_t = A_t \ B_t \ C_t \ D_t \ E_t$

    Also, it is assumed that

(2) $a + b + c + d + e = 1$

(3) $a = \dfrac{P_A \cdot A}{P_0 \ 0}, \quad b = \dfrac{P_A \ B}{P_0 \ 0}$, etc.

    The variables are defined as follows:

        Q_t = predicted output in year t resulting from the use of given amounts

            of inputs considered (A, B, C, D, and E)

        A_t = labor inputs

        B_t = capital inputs (reproducible fixed assets and draft animals defined

            as a flow of services)

        C_t = current purchases from non-agricultural sectors

        D_t = land inputs

        E_t = livestock defined as a flow. Excludes draft animals and other classes

            of animals considered as working capital

        P_A = Price of input A, etc.

        A = Quantity of input A, etc.

        P_0 = Price of output for sale or home consumption

        0 = Quantity of output for sale or home consumption

    The small case letters shown represent the coefficients (or relative shares)

for each of the categories of inputs in total output. The concept of output considered

is value added by agriculture plus purchases from non-agriculture of materials for

current use.

    The second assumption implies constant returns to scale and if each of the factor

is paid the value of its marginal product in the base period each coefficient will

represent the proportionate share of total output. Thus, the third assumption

defines each coefficient as the proportion of total costs of production attributable

to each category of inputs.

B. Estimation of Value of Output for Sale and Home Consumption in 1959

Total value of production for sale and home consumption plus subsidies

to state agriculture is estimated to have amounted to 38,482 million rubles in

1959 in current prices.

The estimate is made up of the following components:

		(million rubles)
1.	Sales to nonagricultural sectors as intermediate product	23,483
2.	Net sales to consumers as final product	4,241
3.	Consumption of farm products as income in-kind	9,800
4.	Net foreign sales	660
5.	Subsidies to state agriculture	300
	Total	38,482

Line 1:

Comprised of receipts of agricultural sector from sales to other producing sectors,

primarily the food and textile industries. This sum of 23,483 million rubles is

comprised of value of purchases by industry of 21,233 million rubles (expressed

in final purchase prices paid to government procurement agencies) as estimated by

Vladimar Treml' (The 1959 Soviet Intersectoral Flow Table, Volume 1, Research

Analysis Corporation, November 1964 p. 97) plus estimated subsidies paid to pro-

curement agencies of 2,650 million rubles to cover the difference between the prices

paid to farms and the lower prices paid by industrial enterprises to procurement

agencies (Abraham Becker, Soviet National Income and Product 1958-62: Part I -

National Income at Established Prices RM - 4394 - PR, Rand Corporation, June 1965,

p. 137) minus estimated turnover taxes of 400 million rubles added to prices paid

the food industry for purchases of grain from procurement agencies (unpublished

estimate by Vladimir Treml').

Line 2: Sum of direct sales by agriculture to the population of 793 million rubles through "commission" stores (Narkhoz. 1962, p. 540) plus 3,448 million rubles of net sales through the collective farm market (3,831 million rubles gross sales Narkhoz .. 1962. p. 540 minus an allowance of 10 percent for trade margin).

Line 3: Unpublished estimate by Constance Krueger. Prices used are the average realized prices received by producers.

Line 4: Value of exports of agricultural products (expressed in domestic prices) is estimated by Vladimir Treml' as 660 million rubles (see _____). *

Line 5: Government subsidies to state agriculture of 167 million rubles for the RSFSR inflated to 298 million rubles (Narkhoz. RSFSR 1960, p. 478) by assuming a proportional subsidy on state farm acreage in the other republics.

*Note to Editor: Reference is to contribution by Treml' appearing in this JEC Compendium.

C. **Estimation of Coefficients**

			When Rate of Return on Fixed Capital and Productive Livestock is	
			8 Percent	13 Percent
1.	a	(labor) =	0.5725	0.5725
2.	b	(fixed capital) =	0.0842	0.1185
3.	c	(current purchases) =	0.1411	0.1411
4.	d	(land) =	0.1731	0.1206
5.	e	(livestock) =	0.0291	0.0473

Coefficients in Columns 1 and 2 are obtained by dividing the payment to each

of the factors of production by the total value of production for sale and home

consumption of 38,482 million rubles. The sum total of the payments to the factors

is equal to the value of output.

1. **Labor**

Sum of wages paid to the labor force engaged in farm activity on

state agriculture and collective farms, sales by households of agricultural com-

modities, and farm income-in-kind. Wages for state agriculture of 3,201 billion

rubles was derived as follows:

Average annual wage of 642 rubles plus payments to social insurance of 4.4

percent for a total return of 670.2 rubles per average annual worker. The average

annual wage for 1959 is obtained as the mean for the years 1958 and 1960 (average

monthly wages of 53.1 and 53.9 rubles, respectively, times 12, Narkhoz. 1964, p. 555).

The deductions for social insurance is equivalent to 4.4 percent of the annual wage

(V. Krilikoskaya et. al., Planirovaiye byudzheta gosudarstvennogo sotsial'nogo

strakhovaniya. 1959, p. 18). Average annual number of workers in farming activity

in 1959 came to 4,557 thousand in state and institutional farms and 219 thousand

in machine and repair tractor stations (/ Se'lskoe Khozyaystvo op. cit. 1960, p. 450, 451, 458). It was

assumed that the average estimated wage for state agriculture was also applicable

for MTS and RTS workers.

The following returns to labor are from unpublished estimates of Constance

Krueger: wages paid to farm members and hired labor by collective farms attri-

butable to farm activity (4,450 million rubles) plus share of net income from

sale by households of farm products attributable to use of labor (4,580 million

rubles) plus income-in-kind (9,800 million rubles).

2. Capital

Charges for capital stock are comprised of three items:

(1) depreciation charges on structures and equipment.

(2) interest on structures and equipment.

(3) interest on horses.

Using alternative interest charges of 8 and 13 percent, the flows come to:

	8 Percent	13 Percent
Depreciation	1,130	1,130
Interest	2,110	3,430
Total	3,240	4,560

a. Depreciation Charges

Depreciation charges were obtained by the use of a 4.5 percent

rate and capital assets valued at 25,100 million rubles in 1959. The relevant

rate for depreciation is assumed to be that used for replacement only excluding

amortization allowances set aside for capital repair. The rate of 4.5 percent

was that implied for 1963 ~   ⊃ for state agricultural enterprises.

Amortization allowances of 905 million rubles were set aside for replacement

against a stock value of 20,200 million rubles (exclusive of livestock). Amorti-

zation deductions are from Narkhoz. 1963, p. 653. A similar rate appears to

be appropriate for collective farms (4.7 percent in 1963 for collective farms

of the RSFSR only - L.N.Kassirov and V.A.Morozov, Khozyaystvennyy raschet v

kolkhozakh and sovkhozakh, Moscow, 1965, p. 45).

The rate for 1963 was deemed to be more appropriate than the implied lower

rate for 1959. Major revisions (upward) in accounting for amortization were

undertaken in 1963 in order to obtain a more realistic set of allowances.

The data cited above for value of assets (including draft animals) are

from unpublished estimates of Scot Butler.

b. Interest Charges

As indicated above I have arbitrarily used alternative rates of

return of 8 and 13 percent. Until this year (1966) there has not been an explicit

charge levied on reproducible assets in the Soviet economy. Investment funds for

state enterprises were for the most part part provided either on a grant free

basis from the State Budget or from retained profits of the enterprise. But

under the provisions of the new planning system for industry a charge will be

..evied on undepreciated value of capital stock. For the enterprises to be

transferred to the new system in 1966 the charge will vary from 3 to 8 percent,

but this is a "minimum" to be increased in the future (Finansy SSSR, no. 3, 1966,

p. 23-24). Soviet economist are discussing a future range of interest rates of

6 to 12 percent with some arguing in favor of a higher rate of 15 percent.

The average rate of return in the U.S. on depreciated capital in manufacturing

enterprises (before taxes) between 1946-58 came to 11 percent (George J. Stigler,

Capital and Rates of Return in Manufacturing Industries Princeton, New Jersey,

1963, errata statement p. 8). The implied rate on undepreciated capital would,

of course, be lower.

In the case of the Soviet Union one would expect to observe a higher rate

of return than in the U.S. because of the greater degree of scarcity of this

factor of production in the Soviet economy compared to other resources (e.g.

labor). Moreover, the priorities of Soviet planners are such that the "recoup-

ment rate" used by planners as a rule-of-thumb measure in choosing among alterna-

tive uses of investment is higher for agriculture than it is for, say, heavy

industry.

3. Current Purchases

Current purchases of materials from non-agriculture sectors of

5,428 million rubles are from Treml' (op.cit.,). in The 1959 Soviet Intersectoral...., Treml' has included services

purchased from transportation, communications, internal trade, and distribution.

For present purposes of obtaining net purchases by agriculture from the rest of

the economy these are excluded on grounds that most of the expenditures reflect

double counting of outlays (e.g. trade and transportation) which are included

in purchases from other sectors (e.g. food industry).

4. Land

The return to land of 6,660 and 4,640 million rubles (Column 1 and

Column 2) was obtained as a residual. It is the difference between total value

of sales and home consumption for agriculture of 38,482 million rubles and the

summation of the payments to the other factors (lines 1 to 3 and line 5).

5. Livestock

Comprised of interest charges of 1,120 and 1,820 million rubles,

respectively. These are imputed charges based on assumed rates of return of

8 and 13 percent on total estimated value of herds of 14,000 million rubles

which is the mean of end-of-year values for 1958 and 1959 of 13,800 and 14,200

million rubles, respectively. Values of herds of productive livestock estimated

by Scot butler (unpublished estimates).

Appendix D

Alternative Indexes of Inputs and output Per Unit of Input

The index of total inputs and factor productivity shown in Table 5 of the

text (p.   above) was based on a set of weights for the geometric index formula

that reflected an interest rate of 8 percent on fixed assets and livestock and

the use of man-days as the indicator for the input of labor.

In Table 15 the 2 indexes derived by use of the 8 percent rate of return

(labor, alternatively, expressed as man-days and employment) are compared to

those derived with a rate of return of 13 percent. The latter rate was arbi-

trarily chosen to test for the sensitivity of the results to variations in the

assumed contribution of fixed assets and livestock and the return to land

obtained as a "residual." The overall conformation of trends in inputs and

output per unit of input are not seriously modified (see Table 16).

Table 15

USSR: Indexes of Output and Inputs in Agriculture, 1950-65

1950=100

	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
Output:																
1. Straight Annual	100	97	104	106	109	126	141	141	155	149	150	163	161	153	170	171
2. 3 Year Moving Average	100	101	103	108	115	127	138	147	150	153	156	160	160	163	166	
Inputs:																
3. Rate of Return on Capital and Livestock - 13%																
a. Labor as numbers principally engaged	100	101	101	106	108	112	116	121	128	130	129	132	138	140	143	
b. Labor as man-days	100	N.A.	100	106	110	117	121	123	126	129	128	132	136	137	140	
4. Rate of Return on Capital and Livestock - 8%																
a. Labor as numbers principally engaged	100	101	101	105	107	111	115	119	125	126	126	128	133	134	137	
b. Labor as man-days	100	N.A.	99	105	109	116	120	121	123	125	125	128	132	132	134	

Table 16

USSR: Alternative Indexes of Agricultural Output Per Unit of Input, 1950-65

1950=100

Output/Input	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965
A. Output as 3 Years Moving Average																
1. Index of Inputs - 13% Rate of Return																
a. Labor as numbers principally engaged	100	100	102	102	106	113	119	121	117	118	121	121	116	116	116	
b. Labor as man-days	100	N.A.	103	102	104	108	114	120	119	119	122	121	118	119	119	
2. Index of Inputs - 8% Rate of Return																
a. Labor as numbers principally engaged	100	100	102	103	107	114	120	123	120	121	124	125	120	122	121	
b. Labor as man-days	100	N.A.	104	103	106	109	115	121	122	122	125	125	121	123	124	
B. Output as Straight Annual																
1. Index of Inputs - 13% Rate of Return																
a. Labor as numbers principally engaged	100	96	103	100	101	112	122	117	121	115	116	123	117	109	119	
b. Labor as man-days	100	N.A.	104	100	99	108	117	116	123	116	117	123	118	112	121	
2. Index of Inputs - 8% Rate of Return																
a. Labor as numbers principally engaged	100	96	103	101	102	114	123	118	124	118	119	127	121	114	124	
b. Labor as man-days	100	N.A.	105	101	100	109	118	117	126	119	120	127	122	116	127	